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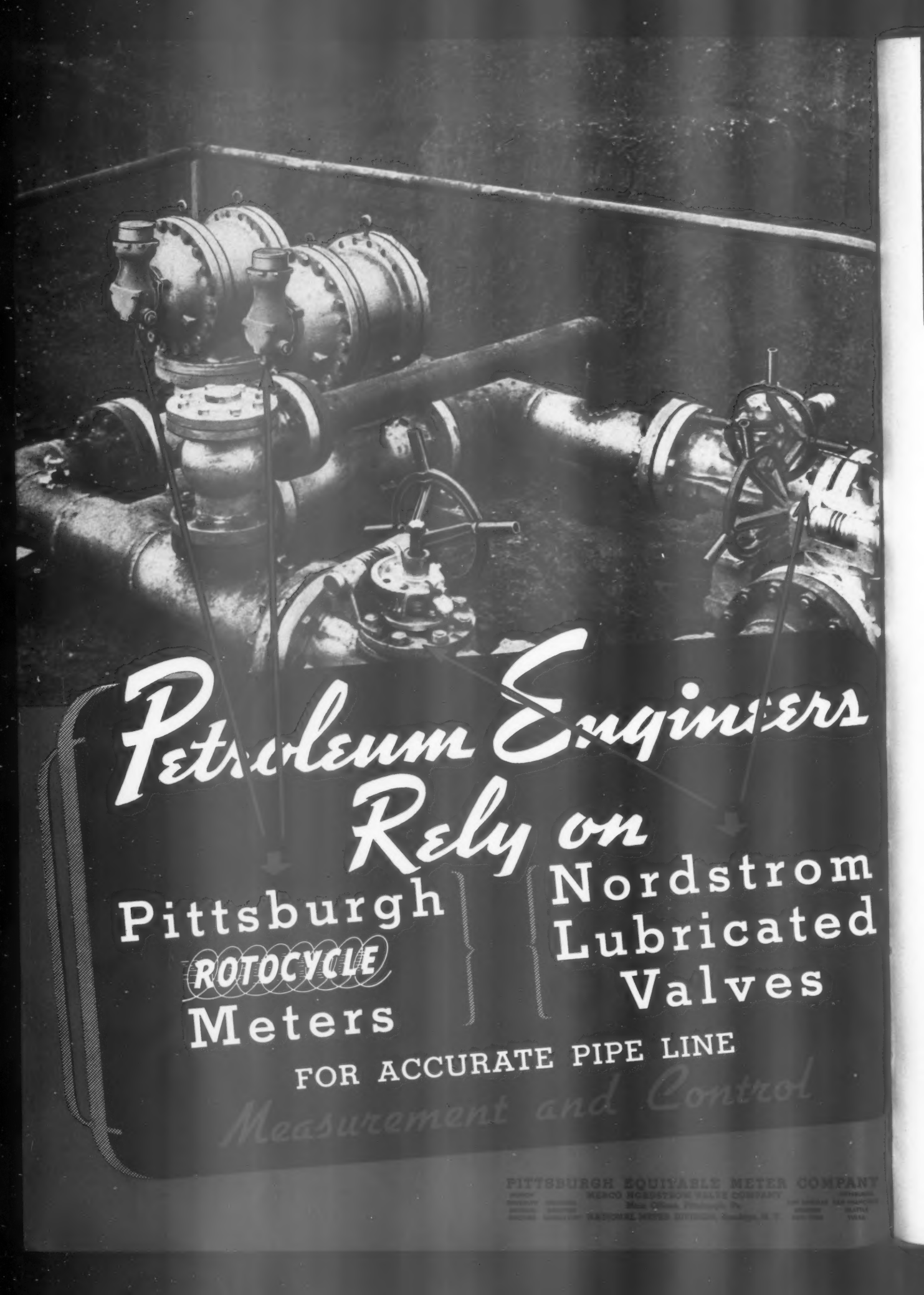
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the OIL AND GAS JOURNAL

Trends

Crude-Oil Production By States—Page 262

CRUDE PETROLEUM 4,368,710 bbl. daily average—up 29,095 bbl. One year ago 3,923,950 bbl.

CRUDE STOCKS 234,389,000 bbl. as of Sept. 11—down 246,000 bbl. One year ago 244,671,000 bbl.

GASOLINE STOCKS 71,928,000 bbl. as of Sept. 11—up 526,000 bbl. One year ago 80,224,000 bbl.

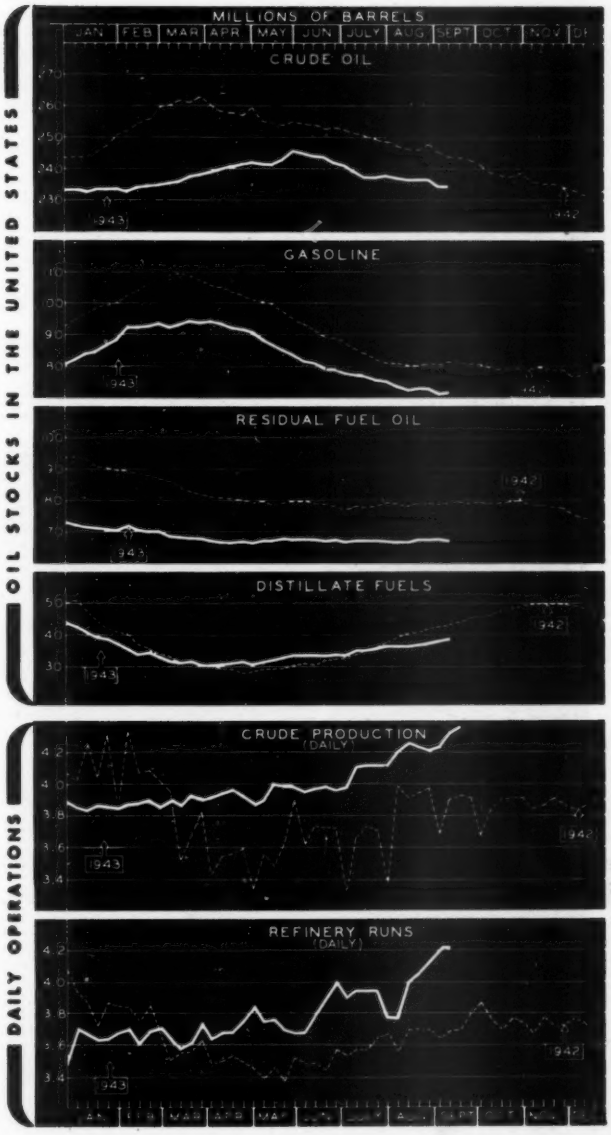
RESIDUAL FUEL-OIL STOCK 67,011,000 bbl. as of Sept. 11—down 664,000. One year ago 79,019,000 bbl.

GAS OIL AND DISTILLATES 39,401,000 bbl. as of Sept. 11—up 728,000 bbl. One year ago 44,216,000 bbl.

REFINERY RUNS 4,216,000 bbl. daily week ended Sept. 11—up 2,000. One year ago 3,737,000 bbl.

WITH both crude-oil production and refinery operations so far this month running ahead of expectations operators will be asked next month to further expand their activities. The reaction within the industry last week when the October crude-oil production schedules were announced, was that the allocations could be met. In fact, as has been the case for several months, both producers and refiners as groups will endeavor to exceed the recommended operations. In general the actual demands have been in excess of the government recommendations and operators have been compelled to draw on crude-oil storage and refiners have not been able to maintain working requirements of finished products in many instances. So far as crude-oil storage is concerned few large or small companies have more than minimum working requirements. At the same time refiners do not have stocks on hand to support the seasonal demands. These refiners are hopeful that during October they will be able to get away from the "hand-to-mouth" operations in which shipments from plants have only been a few hours behind the manufacture of finished products. It is understood that the Government is also anxious that weak inventory positions be strengthened.

AS has been the case for several months practically all of the expansion in operations in October will take place in Texas. In fact, next month the increase in Texas allocation of 90,000 bbl. daily of liquid petroleum more than offsets the national increase of 86,600 bbl. daily. To transport the Texas production of 2,000,000 bbl. daily next month will require practically all the pipe-line facilities now available, according to those in close touch with conditions. A large line extending from the Corpus Christi area to Houston is expected to be in operation and the required water-shipping facilities will be available. Part of the increased production will come from the sour-crude fields and it is explained that plant facilities have been provided to refine this crude in the coastal areas. It is also reported that the October schedules assume that a 75,000-bbl. refinery located in the Gulf Coast area will be in operation next month. This plant is the largest new refinery to be built during the emergency and its output until the war ends will center in the manufacture of war products, including 100-octane gasoline and components required in the production of synthetic rubber. Existing refineries in the Gulf Coast area will also greatly increase their output of war products next month.



Forces Remain Deadlocked in Price Issue Pending Vinson's Decision

WASHINGTON, D. C. — Opposing forces in the fight over higher crude-oil price ceilings remained deadlocked this week, pending a decision from the Office of Economic Stabilization where the issue now rests. Formal disposition of the appeal taken by the Petroleum Administration for War to OES in exception to refusal of the Office of Price Administration to sanction a recommended advance of 35 cents per barrel must be awaited before further tactics in the battle are employed.

Rumors circulated a week ago that OES was prepared to recommend a 25-cent advance subsided, although oil-industry representatives here, following developments, anticipated that Judge Vinson's decision would be reached in the near future.

Meanwhile, a bill was introduced in the House prohibiting the OPA or any other regulatory agency from establishing a petroleum-price ceiling until the market had reached a minimum of $2 a barrel.

Another blast was fired September 20 by Sumner T. Pike, chief of the OPA Petroleum Price Division, at proponents of higher crude prices. He testified before a Senate committee investigating a farm-gasoline shortage and motor-fuel prices that wildcat drilling operations are surpassing all former records. His declaration was made in refutation of allegations that OPA's rejection of a general crude advance had hampered exploratory drilling.

Pike's Logic Questioned

Oil men, however, were prompt in pointing out that Mr. Pike's facts are accurate but that the industry disagrees violently with his conclusions and his logic. Assertions were made following Mr. Pike's testimony that a slight increase in exploratory drilling has proven insufficient to keep the rate of discovery in reasonable balance with production. Oil men long have contended that the exploratory rate should be raised sharply to offset the higher rate of production and to increase the producibility of the nation's reserves. The necessary stimulation to wildcat drilling, oil men argue, can be given only through the medium of a general price advance. They say it is no more logical to expect the oil industry to meet expanded wartime demands at a normal rate of operations than it would be to satisfy military requirements for steel at the peacetime rate of manufacture.

Indications are, Mr. Pike told the Senate committee, that 3,300 wildcat wells will be drilled this year as against 3,219 last year, 3,264 in 1941, 3,038 in 1940 and 2,589 in 1939.

"More fields also were brought in last year than ever before," Mr. Pike said. "There doesn't appear to be much basis for the charge that OPA ceiling prices have ruined wildcatting."

He said, however, the nation's oil production has not kept pace with demand, and predicted that importation of oil would have to be increased "in the near future."

Senator Bushfield, of South Dakota, said he understood plans called for importing 1,000,000,000 bbl. of oil next year, and Mr. Pike said that sounded "logical."

Exception also was taken to the figure on probable imports. It was pointed out that the rate considered "logical" by Mr. Pike would average more than 2,700,000 bbl. daily which is more than half of the current daily domestic production.

Harris & Ewing

OES Director Vinson, whose decision is awaited to break the price stalemate

Brown Finds Error in President's Calculation Of Oil Productivity

WASHINGTON, D. C.—An error in calculating the petroleum industry's productivity by President Roosevelt in his recent message to Congress was pointed out this week by Russell B. Brown, general counsel for the Independent Petroleum Association of America. The President told Congress that since the outbreak of war in Europe the country has increased its output of petroleum 66 per cent.

"It is unfortunate," Mr. Brown said, "because, first, it indicates a productive capacity of the fields of this country equal to the demands being made upon them. That certainly is not the case. Secondly, some mistake in the calculations must have been made, because no such gain has occurred.

"If we take September 1, 1939, as the beginning of the war in Europe, the daily average production of crude oil in the United States for that

month, according to the United States Bureau of Mines, was 3,608,000 bbl. The latest official figure, compiled by the same authority, was for June 1943, when the daily average was 3,977,000 bbl. The increase, comparing these 2 months, was 10 per cent. Unofficial figures for August 1943 indicate a daily average production of 4,217,000 bbl. and that would be an increase of 17 per cent compared to the month of the outbreak of war in Europe.

"No possible combination or arrangement of petroleum production figures would yield the reassuring impression that our producing capacity is adequate.

"The President," Mr. Brown said, "cannot personally spare the time to analyze the statistics on petroleum. His office might instruct those responsible for the miscalculation on which the statement in his message was based to supply him at once the correct data."

Equipment Suppliers Told How WPB Petroleum Section Functions

SIMPLIFIED machinery created in the War Production Board for handling petroleum-equipment priority problems was explained in Tulsa and other Mid-Continent oil centers last week by three representatives of Washington agencies.

Alvin Zwerneman and W. E. Batchellor, from the staff of the PAW Materials Division, and Myron C. Schoenly, chief of the petroleum-equipment section, Wholesale and Retail Trade Division, WPB, composed the party from Washington. They came to the Mid-Continent for across-the-table discussion of petroleum-equipment problems with supply companies, manufacturers and operators. Two of the 3 days spent in the Mid-Continent were devoted to calls on supply companies and manufacturers. A field trip to Seminole and Oklahoma City for the purpose of familiarizing Messrs. Batchellor and Schoenly with operating practices concluded the Mid-Continent visit. Mr. Zwerneman was vice president of Axelson Manufacturing Co. before joining PAW.

The new WPB petroleum-equipment section headed by Mr. Schoenly was created August 23 and is to function as the central clearing agency for oil-supply allocations. All branches of the industry negotiating with WPB for critical materials will, under the newly organized procedure, direct their applications to Mr. Schoenly's section.

Previously, manufacturers, supply houses and operators were compelled to deal with an amazingly complex organizational setup. Requests for flashlights, for example, were routed to one section; applications for wire rope went to another; manila cordage was under the jurisdiction of still another section of WPB, and so on. If the materials required are for petroleum operations, regardless of whether they are under the direct jurisdiction of the copper division, heat and power section or any of the other subdivisions, it will be Mr. Schoenly's assignment to work out details of procedure, carry through negotiations until the application is either honored with a specific allocation or rejected.

Equipment manufacturers and supply representatives agreed that part of the priority battle could be considered won. Mr. Schoenly formerly served in the PAW Materials Division, although much of his previous business experience was in general material distribution in heavy industry and not specifically concerned with petroleum equipment. He carried on much of the liaison work with WPB while a member of the PAW organization.

Five-Point Program Proposed to Relieve Drilling

WASHINGTON, D. C. — Petroleum Administrator Ickes warned here this week that unless former oil workers can be persuaded to return to the industry, the manpower shortage will result in the wildcat and oilfield development programs falling far behind schedule.

Meanwhile, he laid before the industry a five-point program for maximum efficient use of what manpower is available and strongly urged the industry to follow the recommendations.

He made his warning on the basis of a partially completed survey of the labor supply in the drilling industry, which he said not only disclosed major delays in getting wells completed, but gave evidence of a more serious shortage in the near future.

Mr. Ickes said that steps would be taken to attempt to get some of the workers back into the industry as speedily as possible.

"In the meantime," the administrator disclosed, "it is urgently necessary that the industry utilize to the fullest extent every man presently available to it. With this in mind, we believe it is consistent to urge that producers and operators who employ the services of drilling contractors give serious consideration to the following five points:

"1. That the drilling of wells by producing companies be scheduled in advance to produce a continuity of operations for the contractors' crews and equipment, in so far as is practicable.

"2. That the contractor be given notice at least 30 days prior to the time of permanently releasing his men and equipment so he may seek work elsewhere for this equipment and these crews.

"3. That companies contemplating the use of contractors' services give the contractor as much as 30 days' notice, whenever practicable, before requiring him to move onto a new location.

"4. Where an unavoidable delay may be occasioned and the time for such delay can be computed, that the contractor be notified of the length of such delay so that his men will be laid off for only a definite period of time, instead of indefinitely.

"5. In proven territory where use of more than one rig is contemplated by a producer, permit the contractor to have at least two rigs in operation so that a saving may be effected in supervision, trucking facilities and equipment used in setting various sizes of casing."

Patton Named Director of Gas, Gasoline Division

Mark S. Patton, president, Hurley Gasoline Co., Tulsa, who has been serving as assistant director of natural gas and natural gasoline for District 2, PAW, last week was made director. He succeeds Seth W. Herndon, Tulsa, drilling contractor, who resigned last month to devote full time to Herndon Drilling Co.

Work Begun on Warren's Casinghead Gasoline Plant

MARSHALL, Tex. — Construction has been started on a $100,000 natural-gasoline plant in the Hawkins field on the southern border of Wood County, Texas, for Warren Petroleum Corp.

The plant will comprise four units and is being built on the Whit Moore farm 3 miles northwest of Hawkins.

N.P.A. Hears Pogue's Proposal for Balanced World-Petroleum Program

*by Joseph E. Pogue**

THE war has brought about important changes in the petroleum situation and through its stimulating effect upon demand, on the one hand, and its retarding effect on field developments, on the other, has created an entirely new relationship between prospective supply and demand. The record of the petroleum war economy is being written in two chapters, the first of which is nearly completed. The events of chapter one were primarily concerned with the far-reaching transportation dislocations created by the submarine campaign. During the first 18 months of the war the major problems involved the establishment of transportation detours to meet essential requirements with minimum utilization of tankers, and the elimination of all dispensable consumption to ease the load. The shrinkage in tanker availability had to be countered by the development of extraordinary methods of transport overland and the taking of ocean-borne supplies from the nearest sources.

The second chapter in our current oil economy is introduced by a radical improvement in transportation capacity, as a result of the completion of extensive pipe-line facilities and the favorable crossing of the curves of tanker construction and tanker sinkings. The breaking of transportation bottlenecks simultaneously on land and sea has fundamentally altered the economic and administrative problems of the oil industry and brings to the fore the elements of supply heretofore hidden behind transport barriers. But the problems of supply were not only masked during the events of chapter one, they were actually latent so long as demand had not risen to the zone of productive capacities. Now, however, the convergence of the trends of supply and demand is creating a new set of problems just as our transportation limitations are eased.

Petroleum production in the United States has enjoyed a rising trend since the inception of the industry, but the basis of production—the discovery rate—has fluctuated in conformance with price, the trade cycle, the emergence of new techniques, and other factors. For several years the trend of discoveries has been downward (although some reversal is apparently in evidence in 1943), but whether the decline in the discovery rate is a cyclical manifestation or else a subnormal level of discoveries will continue as a permanent condition is indeterminate, although the latter is perhaps the prevailing view. At the same time the demand for domestic crude oil, augmented by enormous military requirements, has been expanding sharply and against this trend our domestic oil fields cannot long meet the full requirements without strain.

*Vice president, The Chase National Bank.

Producibility Limit Approached

When the producibility of the domestic oil reserve is examined in terms of rising requirements, it is found that a limitation is rapidly being approached. The economics committee of the Petroleum Industry War Council, in its July report, gave the results of a detailed study in these terms: " . . . for 1944 and 1945 the oil fields of the United States should not be counted on to produce *without waste* (italics mine) more than 4,200,000 to 4,300,000 bbl. of crude oil per day. . . ." Domestic production, which understates demand because crude oil stocks are being drawn upon, crossed 4,200,000 bbl. per day in August, so that the estimated zone of maximum efficient production for American oil fields has already been invaded.

Production experience over the past 15 years has thoroughly established the principle that if production in any field is allowed to exceed a certain level called the optimum, or maximum efficient rate, there is both a loss in ultimate recovery and a subsequent decline in producibility, perhaps on the average to the extent of 25 per cent. Production in excess of the maximum efficient rate for the country at large should be avoided if possible and resorted to only in case of sheer necessity. In the face of a demand such as now in prospect, there are only four ways in which wasteful production can be avoided. First, civilian consumption might be restricted in further degree, but aside from more effective enforcement of gasoline rationing there is little slack to take up on this score without encountering the danger of impairing the domestic economy. Second, higher prices or tax abatement measures could stimulate discovery and producibility, but there has been long delay in invoking these developments. Third, military and lend-lease demands might be reappraised in the light of the new conditions and adjustments may be possible in this field. Fourth, the allocation of demand to available sources of supply could be placed on a world basis and a more efficient flow-pattern developed and induced by the development of facilities appropriate to this end. Gain can doubtless be made in all four categories, but an effective safeguard against wasteful production and unnecessary depletion of the domestic resource requires a world basis for supply.

Desirability of a balanced world program for the production, refining and shipment of petroleum is argued in this paper which was presented September 21 by Dr. Pogue before the National Petroleum Association's annual meeting in New York. He points out the dangers of exceeding the optimum rate of production in domestic fields and dwells on the producibility of fields in the Middle East and Caribbean areas. A related story on the postwar foreign producing prospects starts on page 90 of this issue.

Fortunately the importance of a balanced world program for the production, refining and shipment of oil is fully appreciated in many quarters and the techniques are available for its implementation. What is needed is a more balanced allocation of world demand to all available sources of supply. It is believed that a fully integrated effort along the lines indicated above can obviate the undue impairment of the domestic oil resource. It is to the interest of both the war effort and the domestic economy that this be done, and the improving tanker situation makes this possible.

It is well known that the reserves

(Continued on page 94)

OWI Radiophoto from International News

Here's one way to increase the Allied supply of aviation fuel. Fleeing Nazis left these drums of fuel and the two planes behind at an Italian airdrome in the Salerno area when the Allied forces moved in last week

THIS WEEK

PRODUCTION—Texas sets October allowable at all-time peak of 2,013,279 bbl. daily. . . . Normal under production of 6.4 per cent, estimated 116,000 bbl. daily of natural gasoline and allied products, lowers probable crude withdrawal to 1,884,429 bbl. daily. . . . Other four PAW producing districts substantially unchanged from September quotas. . . . Breakdown between crude and light products shown for first time by PAW. . . . Approximate October crude requirements set at 4,638,700 bbl. daily. . . . Remainder of 265,800 bbl. daily consists of natural gasoline, condensate. . . .

REFINING—District 4 refiners instructed to increase yields of motor gasoline and light fuel oils, depress residual manufacture. . . . Directive abolished, holding gasoline output to 80 per cent of 1941 average. . . . ¶Defense Plant Corp. approves contract with Humble Oil & Refining Co. for $2,750,000 hydrogenation unit. . . .

NATURAL GAS—Federal Power Commission authorizes construction of Tennessee Gas & Transmission Co. 24-in. line from Southwest Texas to West Virginia. . . . Hope Natural Gas Co. application for Hugoton-West Virginia line reset for hearing October 5. . . .

SUPPLIES—East Coast inventory index rises to 41.9 per cent of normal. . . . Small increase reported in furnace-oil stocks. . . . ¶Critical review of B and C coupons in eastern states may lead to modification of restrictions on average civilian drivers. . . .

TRANSPORTATION—Thirty to sixty-day delay announced in completing WEP 20-in. products line to Norris City. . . . Competing war demands prevent scheduled delivery of certain necessary facilities. . . . ¶Tank-car movement of sulfur crude, averaging 25,000 bbl. daily, starts from Midland, Tex., to District 2 refineries. . . . ¶Magnolia Pipe Line Co. to let contract next week for Midland-Corsicana, Tex., line. . . .

PRICES—Deadlock continues between opposing forces in crude-oil ceiling controversy. . . . Decision from Fred Vinson, OES director, awaited. . . . ¶House bill, introduced last week, would prohibit OPA from regulating crude prices until market reached minimum of $2 a barrel. . . . ¶Gulf Oil Corp. raises posting in Jackson and Tillman counties, Oklahoma, to par for other Mid-Continent crude. . . .

DRILLING—Administrator Ickes proposes five-point program to relieve manpower problem in drilling industry. . . . Projection of rig requirements over longer period basic in his recommendations. . . . Warns of acute conditions ahead unless corrective steps are taken. . . .

Bob Allen Selected to Direct A.P.I. Department of Information

NEW YORK.—Robert E. Allen, former assistant deputy petroleum administrator, last week was appointed director of information for the American Petroleum Institute. Selection of Mr. Allen to direct the program was the first step in what W. R. Boyd, Jr., A.P.I. president, described as "a long-range campaign to help the petroleum industry keep the American public thoroughly informed on the facts of oil."

Provision for the new A.P.I. Department of Information was made September 1 when the executive committee authorized Mr. Boyd to select a director and approved an annual budget of $50,000 to cover all functions of the organization.

Background in Oil

"To his new duties," declared Mr. Boyd in announcing selection of the director, "Bob Allen brings a wealth of experience and knowledge of the industry which he has served since his high school days in the oil fields of West Virginia. Since that time, petroleum has been both his vocation and avocation.

"Trained in the oil fields and schooled in geology and engineering at West Virginia University, Bob Allen has now completed a cycle of petroleum-industry experience that peculiarly qualifies him to help the industry tell the story of oil. Since his appointment as director of production in the Office of Petroleum Coordinator in June 1941 and his subsequent promotion to assistant deputy administrator of PAW in January 1942, he has been telling official Washington, Congress, and federal and state administrative agencies that the war could be neither fought nor won without oil and that fighting oil could not be had without the vast tonnage of materials and equipment that was necessary to drill wells, build pipe lines, construct new refineries and provide essential distribution facilities.

ROBERT E. ALLEN

Experiences Extensive

"In pursuit of oil, Mr. Allen has traveled and worked in the principal oil states of this country and also in Australia, Canada and Mexico. He was called by Secretary Ickes and Deputy Administrator Ralph K. Davies from the chairmanship of the Alberta Petroleum Board of Canada, where he had been directing the development and conservation of oil and gas, to assist in the organization of OPC immediately after its inception and was the first divisional director appointed.

"Most of Bob Allen's recent years have been spent in California where his experience in a wide field with several oil companies and his advocacy of petroleum conservation led to his 7 years' experience as assistant oil umpire of California and as executive secretary of the Central Committee of California Oil Producers.

"His main hobby, as well as his business, is oil. That is why he has been chosen to direct the Institute's department of information and why he has been taken from a tremendously important key position in government to do this job. I am deeply grateful to Secretary Ickes and Deputy Administrator Davies for consenting to release him to the Institute."

Assured Pipe-Line Construction Indicates Exceptional Activity

EARLIER predictions that 6,000 miles of pipe lines would be built in 1943 have been borne out by developments in the first 9 months of the year. Reports indicate that more than 5,500 miles of line have been laid already or are nearing completion for the petroleum and natural-gas industries.

Plans are being made by major companies for starting additional lines in the latter part of this year and early next year totaling at least 2,500 miles. For most of these, federal permits have been granted.

According to a survey of 1943 construction progress, pipe lines of different classifications which have been finished or which are still under construction are as follows: Crude oil, 2,400 miles; products, 2,500 miles; natural gas, 600 miles. Proposed lines are: Crude, 1,000 miles; natural gas, 1,500 miles.

The fact that products lines are not included should not obscure the basic economic situation which favors very extensive projects of this kind for years to come.

The principal future projects for which major companies are now making plans are listed below. These present an outlook which is exceptionally promising for activity ahead at this time of the year.

Allotment of steel for a 1,200-mile 24-in. line for transmitting southwestern gas to Pennsylvania-Ohio industrial area has been assigned by WPB. The steel would be available for either the Hope or the Tennessee projects. FPC approved the Tennessee project September 20 and will hold hearing for the Hope project October 5. It is unlikely that steel will be available for both projects during the war.

Proposed Crude-Oil Lines

Stanolind Pipe Line Co., 385 miles of 16-in. from Slaughter field, Texas, to Drumright, Okla.

Magnolia Pipe Line Co., 381 miles, consisting of 335 miles of 12-in. and 46 miles of 8-in., for main line between Midland and Corsicana, Tex., and Midland-Seminole, Tex., loops.

Proposed Natural-Gas Lines

Cities Service Transportation & Chemical Co., 240 miles of 26-in., between Guymon and Blackwell, Okla.

Hope Natural Gas Co., 1,200 miles of 24-in. from the Hugoton field, Kansas, to Kanawha County, West Virginia.

Tennessee Gas & Transmission Co., 1,200-mile 24-in. line from Corpus Christi, Tex., to connect with existing lines in West Virginia.

Natural-Gas Jurisdiction Stipulated by WPB and FPC

WASHINGTON, D. C. — An understanding was reduced to writing here last week between the War Production Board and the Federal Power Commission on how matters concerning the natural-gas industry will be handled by the two agencies for duration of the war. The agreement defines in detail the respective responsibilities of the two agencies for the purpose of securing maximum efficiency and the avoidance of duplication of effort.

The two agencies, WPB and FPC, made it clear that nothing in their agreement shall be construed to be in conflict with existing arrangements between them and the Petroleum Administration for War.

Responsibilities of WPB

Pertinent parts of the agreement follow:

The WPB has exclusive responsibility for the following problems arising out of the supplying of natural gas for the war program.

1. Development and administration of programs to assure that the equipment and materials which can be made available for the purpose of supplying natural gas are allocated where and when the need is most urgent from the standpoint of the military and war-production program, keeping in mind the needs for natural gas for civilian purposes. This includes priority control and allocations of materials and equipment for all systems transporting and delivering natural gas and for industries operating or installing facilities for the supply or utilization of natural gas.

2. Determination of the supplies of and demands for natural gas in relation to the military and war-production program and essential civilian activities. This includes the programming of natural-gas requirements for war production and for the armed services.

3. The mobilization of natural-gas supplies to meet war-production requirements and the development and administration of programs for better coordination in the operation of natural-gas transportation facilities, including integration and interconnections, to assure an adequate supply of natural gas for war-production industries, the armed services and essential civilian service, including the expansion of existing natural-gas transportation facilities where needed to meet such requirements.

4. The planning, development and administration of natural-gas supply allocation programs for those regions where the available supply proves insufficient to meet all requirements.

Responsibilities of FPC

The FPC will in the public interest continue to exercise its full statutory powers as set forth in the Natural Gas Act, and amendments thereto, the principal of which are as follows:

1. Pursuant to Section 7(a) of the act, to require extension and interconnection of facilities for the interstate transportation and sale of natural gas to distribution companies and distribution centers. Pursuant to Section 7(b), to control the abandonment of facilities and service of natural-gas companies. Pursuant to Section 7(c), to determine whether public convenience and necessity require the construction of new, or extension or acquisition of existing, natural-gas interstate transportation facilities, and to issue certificates of convenience and necessity therefor.

2. The fixing of rates for the transportation and sale of natural gas in interstate commerce; and the control of the importation and exportation of natural gas.

3. The supervision of accounts and rates of depreciation of natural-gas companies subject to the commission's jurisdiction.

4. The collection, compilation and tabulation of information regarding receipts, transportation, distribution and sale of natural gas throughout the United States; and regarding the operation, management, control, service, rates and contracts of agencies transmitting or supplying natural gas.

(Continued on page 101)

PAW Certifies Record Production Quota

WASHINGTON, D. C. — A production rate of 4,638,700 bbl. daily of all petroleum liquids has been certified to the various producing states for October, representing an increase of 86,600 bbl. daily over the amount certified for September. The October quota is 513,300 bbl. daily above a year ago.

Rates of production certified to the eastern, Midwest, Rocky Mountain, and Pacific Coast states (Districts 1, 2, 4, and 5) remain substantially unchanged from the preceding month. The rate certified for District 3 (the southwestern states) was increased by 92,300 bbl. per day, with Texas receiving 90,000 bbl. daily of that amount.

In connection with the certification, Deputy Administrator Ralph K. Davies said:

"Once again Texas is called upon to step up its crude-oil production to provide the additional oil needed for expanding military requirements. Of the 90,000 bbl. per day increase to Texas, 25,000 bbl. daily have been certified for production from the sour-crude oil fields, which are principally in West Texas. Transportation for this additional West Texas production will be provided by tank cars which have been released as a result of the completion of the big-inch pipe line to the East Coast."

Mr. Davies also pointed out that for the first time the certifications indicate the quantity of natural gasoline and condensate which is included in the total quantity of petroleum liquids certified. He stressed the fact that the certifications apply only to the total petroleum liquids and that the quantities of natural gasoline and condensate indicated are only estimates of the amounts of these materials which will be produced in achieving the certified totals.

PRODUCTION RATES

(In thousands of barrels daily)

	Oct. 1943 Certified total petroleum liquids	Oct. 1943 Estimated natural gasoline and condensate	Oct. 1942 Actual prod., total petroleum liquids
District 1:			
New York	14.6	.....	14.9
Pennsylvania	47.0	1.0	49.5
W. Va.	15.6	6.3	17.0
Total	77.2	7.3	81.4
District 2:			
Illinois	219.5	12.0	272.8
Indiana	13.8	.....	17.2
Kansas	300.0	5.7	298.0
Kentucky	26.6	2.6	13.7
Michigan	59.1	0.1	63.2
Nebraska	1.8	.....	2.8
Ohio	10.0	0.4	10.3
Oklahoma	345.7	27.7	404.7
Total	976.5	48.5	1,082.7
District 3:			
Arkansas	81.7	4.7	74.9
Louisiana	375.7	23.0	332.4
Mississippi	50.0	.....	68.6
New Mexico	116.6	5.6	99.4
Texas	1,999.0	127.7	1,492.6
Total	2,623.0	161.0	2,067.9
District 4:			
Colorado	7.0	.....	6.3
Montana	23.4	0.4	22.7
Wyoming	99.6	2.6	88.7
Total	130.0	3.0	117.7
District 5:			
California	832.0	46.0	765.5
Other	.....	.....	0.2
Total U. S.	4,638.7	265.8	4,115.4

FOREIGN OPERATIONS MUST BE EXPANDED

Foreign producing countries, this look-ahead story concludes, must supply larger volumes after the war ends. U. S. postwar demand was analyzed in the June 24 issue.

by J. P. O'Donnell

NOT only a continuation but an expansion of the foreign exploration and production activities which American oil companies have carried on in the past will be necessary in the postwar era. This need arises from the decline in reserves within the United States, this country's position as the world's largest consumer of oil products and the growth in consumption in other countries which is expected to develop after the war.

The decline in United States reserves is too generally appreciated to require explanation here. A ready illustration is available in the survey of reserves prepared by Dr. W. V. Howard (The Oil and Gas Journal, Vol. 42, No. 12) in which he concludes that both discoveries and extensions in the first 6 months of this year were 271,807,000 bbl. less than production. From this it is evident that this country is approaching the limit of its ability to produce from known reserves. The possibility exists that large domestic discoveries will partially or completely correct this condition. This possibility will be enhanced if low prices which have deterred exploration are replaced by sufficient incentive.

Seriousness of the immediate situation becomes apparent when viewed in relation to demand. The PIWC has estimated that demand will require runs to stills of 4,158,000 bbl. per day in the last quarter of this year and, in doing so, "emphasizes the magnitude of the crude-production problem." However, if the average rate of gain in runs to stills from 1932 to 1941 had continued into 1943, they would now be up to more than 4,215,000 bbl. per day. Therefore, our supply problem possibly would have been even more acute and our need for supplementary supplies even greater had it not been for the war.

While the immediate prospects indicate a need for development of foreign resources, more distant prospects tend to emphasize it. Domestic demand for petroleum products in this country grew from 835,482,000 bbl. in 1932 to 1,326,620,000 bbl. in 1940, an average annual increase of more than 60,000,000 bbl. If this rate of increase continues, and predictions of postwar national income indicate that it will, domestic demand will be up to the total of 1,900,000,000 bbl. by 1950. If the ability to produce is not sufficient to supply present demands, and if it is not substantially improved in the interim, a few years from now foreign oil will not be merely desirable but will be imperative.

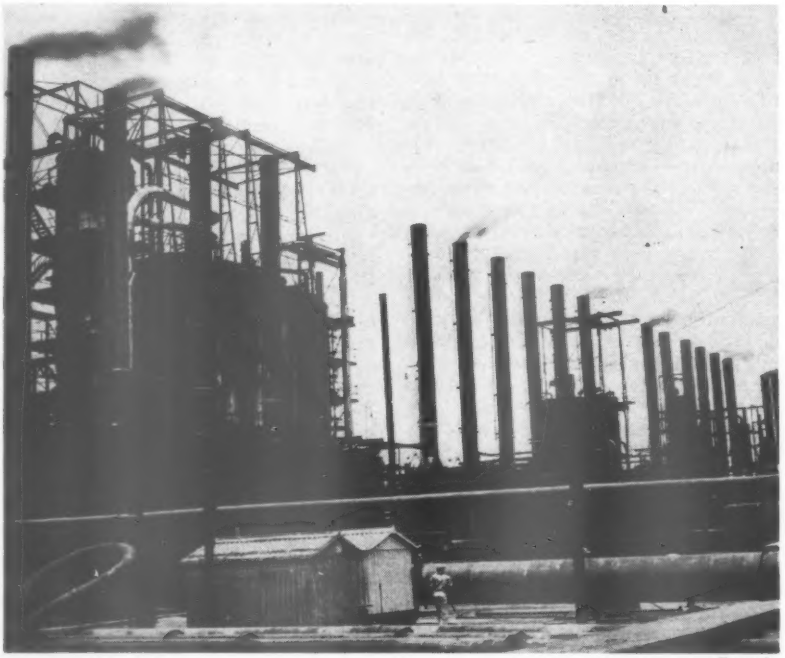
One emphatic reason why it is essential for American oil companies to maintain the leadership in world oil control is that the needs of this country are far greater than those of any other nation. A comparison of the consumption of petroleum products by the 15 major consuming countries in 1939, the last comparatively normal year, is contained in Table 1. This table shows that the United States consumes almost twice as much as all others combined, more than six times as much as the British Empire which is the second largest consumer and two and one-half times as much as the British Empire, Soviet Russia, Germany and France, other ranking consuming nations, combined.

(Continued on page 97)

TABLE 1
15 Major Oil-Consuming Nations—1939

Country:	Total consumption*	Proportion
United States	1,236,076,000	65.15
British Empire	197,515,000	10.42
U.S.S.R.	170,600,000	9.00
Germany	54,000,000	2.84
France	44,200,000	2.33
Holland†	43,100,000	2.27
Argentina	30,950,000	1.63
Japan	25,400,000	1.34
Italy	21,800,000	1.15
Mexico	18,600,000	.97
Rumania	14,400,000	.76
Iran	11,100,000	.58
Sweden	10,950,000	.57
Venezuela	9,530,000	.50
Brazil	9,300,000	.49
15 countries	1,897,521,000	100.00

*Garfias, Whetsel, Riston, Cities Service Co., before A.I.M.E., Feb. 1940.
†Includes East and West Indies.



Severin

Part of the distillation and steam-generation equipment at the Curacao refinery in the Netherlands West Indies

FOUNDED IN 1910

BY PATRICK C. BOYLE

the OIL AND GAS JOURNAL

Inviting Federal Control

THE current agitation in some states to curtail or end the future interstate distribution of natural gas produced within their boundaries is an invitation for the further extension of federal controls of that industry. Washington restrictions in natural-gas operations have steadily been tightened in recent years and bureaucratic officials need only the excuse of ill-advised state policies to make their domination complete.

In this connection the interrelationship of the natural-gas and the petroleum industries in their producing operations should be kept in mind with the knowledge that federal controls applied to one industry must inevitably affect the other.

Without attempting to pass on the relative merits of either the new lines now under consideration or the controversies having to do with the operation of existing systems during the emergency, some basic conditions can be pointed out which should indicate the dangers inherent in any program which seeks to limit the utilization of natural gas to the areas in which it is produced.

Natural gas in its transportation and distribution is essentially a national enterprise. It now has more than 8 million customers with distributing facilities in most of the states. Present sales total approximately 2 trillion cubic feet yearly with annual revenue in excess of 600 million dollars.

In war and peace natural gas has contributed directly to the living standards of millions and provides several services which will continue to be essential in the industrial development of this country.

As old fields have been depleted and outlets increased, it has been necessary to expand trunk lines and gathering systems several hundred to more than a thousand miles from the points of distribution. These extensions have provided outlets for new fields and have brought needed revenue to operators and wealth to the producing sections.

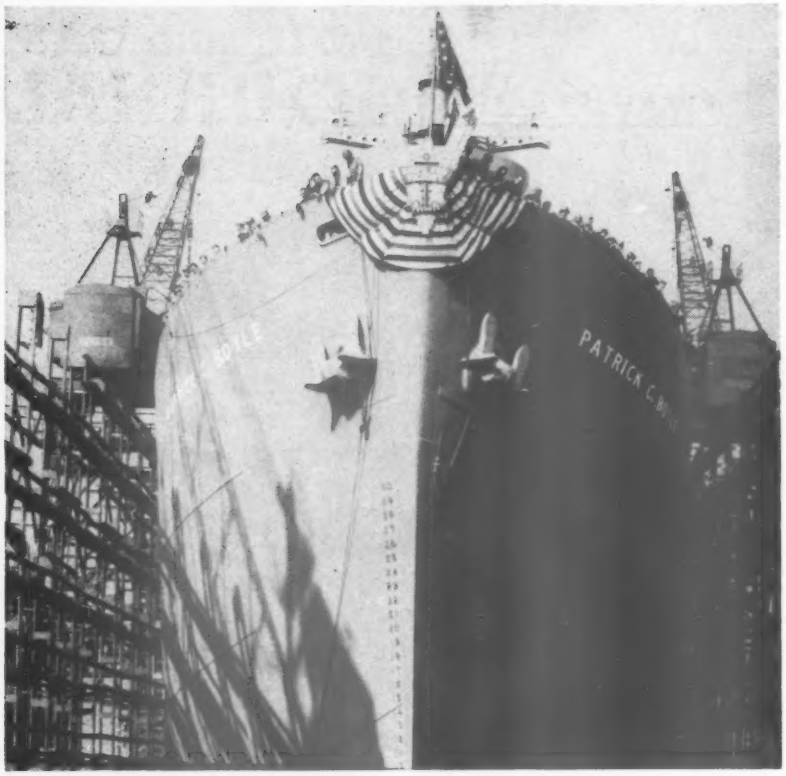
These were logical steps in the growth of one of the major natural resources which, in this country, have always been developed in the interest of all the people and not any particular region.

As demands have increased and supplies have diminished it has been necessary for the area east of the Mississippi River to make new connections to the Southwest where most of the nation's proven natural-gas reserves east of the Rocky Mountains are now located.

This is not the background for the introduction of plans to reserve present and future production to those states in which the largest reserves happen to be located at this time. It is inconceivable that the rest of the country will be willing to rearrange its economy and liquidate investments totaling hundreds of millions of dollars in order that the benefits of natural gas can be retained for the major producing states over an indefinite period.

There are many other facts pertinent to this development. Property rights of producers and the natural-gas industry generally are involved and court decisions clearly are on the side of operators. In the oil industry natural gas is of increasing importance in assuring efficient recovery operations based on conservation principles.

These and other situations point to the need of a country-wide survey covering the future demands and probable supplies of natural gas. But answers to any problems involved must be national and not local in application.



The Patrick C. Boyle as she slid down the ways last week at Baltimore, becoming the first Liberty ship to be named for an early leader in journalism and oil

Journal's Founder Honored As Liberty Ship Is Launched

MEMORY of the man who founded The Oil and Gas Journal and established the Oil City Derrick was honored last week at the Bethlehem-Fairfield shipyards in Baltimore, Md., when the Liberty ship, Patrick C. Boyle, was launched.

The new vessel, 203rd of its type constructed at the yard and the eighth launched so far this month, slid from the ways September 15. Miss Alice Loebelenz, Oil City, Pa., acting as proxy for Mrs. Helen Boyle Lauinger, Tulsa, daughter of the late Patrick C. Boyle, christened the ship. Edward P. Boyle, grandson of the founder, is president of the Oil City Derrick; and P. C. Lauinger, another grandson, is president of the Journal.

Guests at the launching in addition to members of the family were: Congressman Leon H. Gavin, Oil City, who suggested to the Maritime Commission that a Liberty ship be named for Mr. Boyle; Congressman Joseph J. O'Brien, Rochester, N. Y., member of the maritime committee of the House; J. L. Dwyer, of the American Petroleum Institute and the Petroleum Industry War Council, and Mrs. Dwyer of Washington, D. C.

Patrick C. Boyle, in whose memory the Liberty ship was named, was born in Ireland in 1846, came to this country when a child and grew up in the Pennsylvania oil region. In his youth he was an oil scout.

Mr. Boyle founded The Oil and Gas Journal in 1910 after he had established the Oil City Derrick in 1885. He was a charter member of the Associated Press.

In addition to his journalistic accomplishments, Mr. Boyle was prominent in the civic life of Oil City, the oil region, and the commonwealth of Pennsylvania, and was one of the most widely known men in the early oil fields of the nation.

He also fought in the Civil War.

Mr. Boyle is the first of the early leaders in the field of journalism and oil to be honored by the Maritime Commission with the naming of a Liberty ship in his memory.

Tennessee Company's Gas Line Approved

WASHINGTON, D. C. — Federal Power Commission authorized Tennessee Gas & Transmission Co. on September 20 to construct a 1,200-mile natural-gas pipe line from gas fields near Corpus Christi, Tex., to the Appalachian industrial area to meet a wartime fuel shortage. According to the petition the project would cost $55,000,000.

The commission announced its decision in spite of a hearing postponed until October 5 on an application for a line of the same length and diameter from the Hugoton field, Kansas, to West Virginia, by Hope Natural Gas Co.

War Production Board earlier had promised priority for materials for a line of this size but had specified that FPC must decide whether it would be built by the Tennessee or the Hope company. No explanation was available early this week as to the status of the Hope application.

Chairman Leland Olds said the commission decided to act immediately in view of WPB's suggestion that either of the applicants should be in a position to begin placing orders by October 1 for the pipe to insure completion of the line by the winter of 1944-45 when WPB said a serious fuel shortage is threatened in the areas which have been supplied by Appalachian gas fields.

Robert E. May, counsel for the Tennessee company, said that his firm has demonstrated that arrangements have been made to finance the line from Texas.

The Chicago Corp., it was reported here, recently became financially interested in the Tennessee Gas & Transmission Co.

American Liberty Sells East Texas Properties

KILGORE, Tex.—Atlantic Refining Co. has purchased all East Texas properties of American Liberty Pipe Line Co., and 112 producing wells of American Liberty Oil Co. The transaction did not involve a great deal of cash, American Liberty spokesmen said.

The transfer included 87 wells in the Sabine River bed, while the others were in various parts of the East Texas field.

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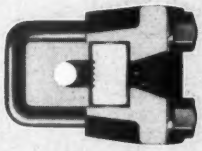

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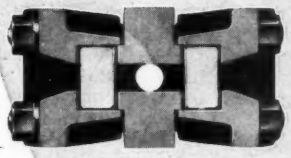

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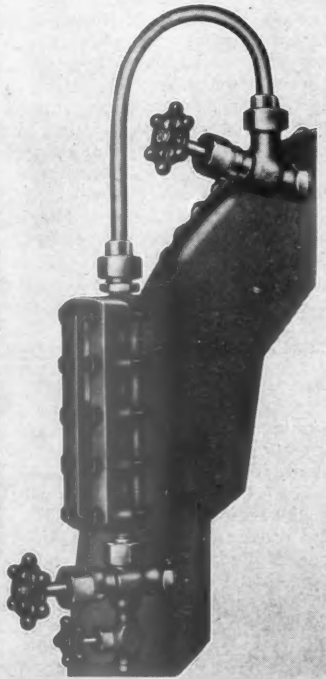

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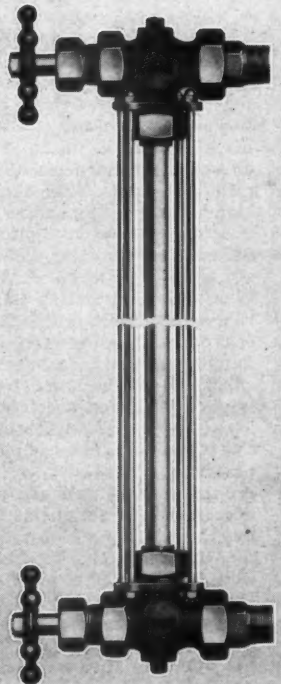


PENBERTHY INJECTOR CO.

DETROIT, MICHIGAN • Canadian Plant: Windsor, Ontario

PENBERTHY PRODUCTS

N.P.A. Hears Pogue's Proposal

(Continued from page 86)

and producibility of oil in the Middle East and in the Caribbean region are much greater than now utilized. Reserves in the two areas combined are larger than in the United States, while producibility from existing wells is several hundred thousand barrels per day in excess of recent takings. True, the limitation in both areas is refining capacity and to some degree pipe-line transportation, rather than producibility, but these bottlenecks can be broken by further installations, on the one hand, and a freer international movement of the oil, on the other. And producibility can be radically augmented by additional drilling.

Whatever the administrative disposition of the problem may be, the economics of the petroleum situation indicate that the oil resources of the Middle East and of the Caribbean region will be drawn upon more fully for war purposes, and future increments to the military demand will be diverted more and more to these sources. In fact, this shift is already well under way. It is clear, therefore, that for the duration of the war the American petroleum industry has become indissolubly linked with foreign sources of supply and no major domestic oil problem can now be resolved except in the light of all foreign alternatives.

Core of Production Thinking

At the very core of all production thinking is the rate of production and particularly the best rate, all factors considered—that rate which has been termed the optimum, or maximum efficient rate. This is the most fertile concept, or discovery, that has emerged from our production experience and it is almost axiomatic that it is unsound to produce any oil field in excess of its optimum rate. It is also important to understand that a field may be soundly produced below its optimum if economic conditions require. The application of the optimum rate, therefore, is not symmetrical in an administrative or economic sense. The economic cost of exceeding the optimum is much greater than that of falling short of it—the first having social implications, the second merely delayed monetary realization. We may therefore set forth the following principle which is thoroughly grounded in established practice and in conservation policies as followed by the state regulatory bodies and the Interstate Oil Compact Commission; namely, the oil fields of the United States should not normally be produced in excess of their aggregate optimum rate nor should they be operated below their optimum rate except to avoid overproduction.

At any given time the optimum rate of crude oil production in the United States must exceed, equal or be less than demand. In the first case, the pressure of supply will tend to create an excess of exports over imports; in the second case, the balance of trade in oil will approach zero; while in the third case, foreign oil will be required to fill the margin and this nation will become a net importer of petroleum. The domestic optimum rate, accordingly, will be the ultimate determinant of the position of this country in respect to imports and exports of oil. But whatever these relationships may turn out to be, the organizing and technical ability of the American petroleum industry should have a great role to play in the development of oil resources the world over.

Postwar Industrial Outlook

The industrial advancement of the world in the postwar period depends more upon transportation than upon any other single factor. No other instrumentality has had a more profound influence upon the world order. Transportation is a stimulant of production and in its presence natural resources and technology combine to create useful commodities. But transportation is not a static concept; it is itself undergoing change. The type of transportation that accompanied and supported industrial developments in the past will have altered and become automotive transportation in the era of reconstruction and expansion that will characterize the postwar period. This change in the form of transportation has been so long under way and its future implications are so obvious as to require no further elaboration here. Petroleum is essential to support the development of the transportation facilities necessary to create rising standards of living based upon expanding production and trade. In this light, petroleum and the industrial structure through which this resource functions take on a pivotal character of the first importance. It is scarcely too strong an assertion that the future of the postwar world is dependent upon the disposition made of petroleum as an economic and social force.

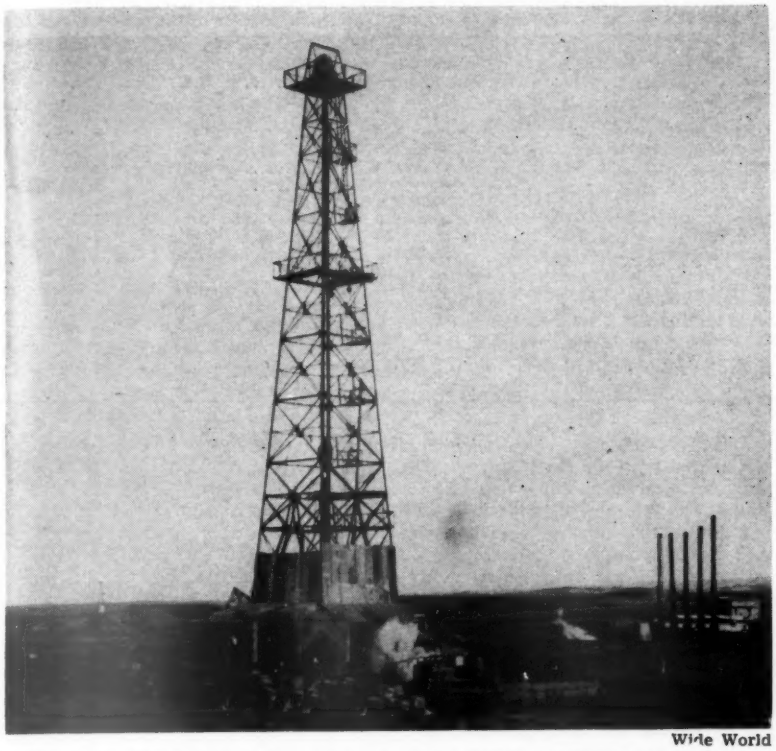
The petroleum industry has developed techniques and operating patterns which will prove invaluable in postwar expansion throughout the world. In addition, it has demonstrated a peculiar genius, derived, no doubt, from the pioneering aspects of the industry, which is difficult to describe and to make clear to anyone who has not lived with this subtle element. It is this genius that has been instrumental in discovering nearly all of the oil found in the entire world outside of Russia, and its techniques have even been contributary to developments there. It is this genius that has in the past 10 years developed in the United States, against almost impossible legalistic odds, a system of efficient production reconciling competition with the advantages of cooperation in oil pools of divided ownership, adapting for this purpose a workable form of collaboration between the individual operators and the oil-producing states—thus revolutionizing engineering practices, equities and political economy in our oil fields. And it is this genius that has facilitated the development during the war period of a system of dual planning and management whereby government and industry are collaborating in the task of directing the complex pattern of petroleum operations to war objectives. These experiences, together with its command of technology, not only fit this industry for participation in the execution of postwar international oil policies but make it essential that its understanding be drawn upon in the formative period of thinking and planning toward those ends.

The problem of postwar world reconstruction cannot proceed along sound economic lines without the establishment of petroleum in a role consistent with its importance. For this purpose it is necessary that the United States formulate a foreign oil policy that will at the same time serve the interests of our country and further the productive capacity and volume of trade of foreign countries. Such a policy should be friendly to American enterprise, which has demonstrated its ability in oil developments the world over, and should have the objective of making foreign oil activities commercially attractive so as to create a dynamic urge toward further progress. To these ends our nationals will need freedom from burdensome operating controls, stability of contracts, and parity with all competitors. If these conditions are provided by international understanding, this country and its petroleum industry can make an outstanding contribution to the future stability and wellbeing of the entire world.

Gulf Equalizes Posting in Jackson, Tillman Area

An advance of 7 cents per barrel in the price for crude in Jackson and Tillman counties, Oklahoma, lifting the postings to a par with other Mid-Continent grades was announced this week by Gulf Oil Corp., retroactive to 7 a.m., September 11.

The new posting raises prices in the Frederick and Altus pools and all crude produced and purchased by Gulf in Tillman and Jackson counties to a range of 93 cents for crude below 25 gravity to a top of $1.25 for 40 gravity and above. The company purchases about 2,000 bbl. daily.



Wide World

A view of the Kirkuk field in Iraq where American, British and French companies have joint interests in one of the world's most prolific fields

Foreign Operations Must Be Expanded

(Continued from page 90)

Since the welfare of the country is so obviously involved, it follows that agencies of the Government exercising control over foreign affairs should formulate and pursue a strong policy of support for the companies engaged in foreign operations. This support does not require participation by the Government in either a supervisory or financial capacity. In both respects the companies have demonstrated their ability to function with unequalled efficiency without outside assistance. Rather it should take the form of assurances that our Government will exert itself to secure equal and equitable treatment for American oil companies in their operations abroad. Furthermore, it could extend its efforts to encourage the admission of American oil capital to those countries which have barred it in the past but which would benefit from it in the future.

The benefits which such nations would derive are many. Primarily they would develop domestic supplies which would make them self-sufficient, a highly desirable status as widespread and severe rationing in the "have not" countries during this war has shown. Secondly, it would provide them with a new industry that would contribute to the support of the country. Colombia, which has encouraged foreign capital to develop its resources, obtained 18 per cent of its total fiscal revenue from the oil industry in 1939. Finally, if the oil operations are sufficiently successful, and in many countries this is more of a probability than a possibility, the nation would have a product for export which would improve its position in international commerce.

Development Incentives

Another consideration for nations which have retarded development through barring foreign capital is that this is the oil era. The possibility exists that the United States will develop an alternative type of fuel if oil becomes difficult to obtain. In this event the genius of American research and industry which is giving this country a synthetic-rubber industry in 2 years would be turned to the development of synthetic fuels. With vast reserves of oil-bearing shales and coal as raw materials and with processes already developed, the creation of a synthetic fuel in ample capacity is readily possible. Loss of the United States market, accounting for two-thirds of the world market, would reduce the value of the crude oil substantially.

The U. S. Department of State has recognized the importance of this country's stake in the world oil supply in the past. Following World War I it insisted on participation of American interests in the division of petroleum resources taken from Turkey and, as a result, American companies share equally with French and British concerns in what is now Iraq. There are indications that the department still holds a sympathetic attitude. These indications are contained in a paragraph from an article by Herbert Feis, adviser to the secretary of state on international economic affairs, which appeared in Foreign Affairs (Apr. 1943). In this article, Mr. Feis stated:

All Seek Adequate Supply

"Since petroleum is the basic fuel of peacetime life and the essential fuel of military action, it is of all raw materials the one apt to command the greatest interest. Every nation will want assurances that under any possible future circumstances of peace or war it will have sufficient supplies available. For such assurance, it must look first to the enlargement of the flow and supply of oil throughout the whole world, and secondly to the sufficiency of its own reserves and the political and military factors which safeguard them. Only by frankly recognizing each other's needs, and by sharing and partnership, can conflict be avoided in this matter, not only by the United States and Britain, but by other nations as well. American enterprise has led in oil discoveries and development throughout the world. We have drawn upon our domestic reserves with freedom. Now we are drawing on them even more heavily in order to supply the war requirements of all the United Nations. It will be essential, therefore, that American oil enterprise go forward in foreign fields, in close agreement with other governments and peoples concerned, to assure adequate supplies for all countries on favorable terms and to maintain adequate reserves for our own use."

The extent to which American companies participate in world crude-oil production is indicated in Table 2 listing the production of the more important producing countries in 1940 and its control. By possession of the reserves of this country, America leads in control of the world's known resources. Wallace Pratt in "Oil in the Earth" estimates that, including the United States reserves, American companies control 60 per cent of the world total, Great Britain 25 per cent and Russia, 10 per cent. Of reserves outside the United States, Mr. Pratt estimates that American control is in the range of 25 to 30 per cent, with about 50 per cent in control of the British and about 20 per cent Russian. The position of the United States in the world picture is not bad as it is now but if domestic reserves are not expanded, foreign reserves under

American control must be to maintain reserves in proportion to requirements. Great Britain, with 25 per cent of the world's reserves and 10 per cent of consumption, is happily situated.

Only a half dozen American oil companies have major proven producing properties outside this country: Standard Oil Co. (New Jersey); Gulf Oil Corp.; Texas Co.; Socony-Vacuum Oil Co., Inc.; Standard Oil Co. of California, and Sinclair Oil Corp. Major foreign companies are Royal Dutch-Shell, which was domiciled in The Hague before the invasion of the Low Countries, and Anglo-Iranian Oil Co., Ltd., of London. There are three great oil-producing regions in the world and one of lesser importance. The Caribbean-Gulf of Mexico region, the Caspian basin region of southern Russia and the Netherlands East Indies, ranked in order of recent production. United States companies dominate the first with Royal Dutch-Shell ranking second. Anglo-Iranian dominates the Persian Gulf area, though American companies hold extensive properties which have proven worth. Shell is dominant in the East Indies, but here again American companies are important and probably will become increasingly so.

Areas which will probably witness the most immediate and extensive postwar development outside of the state-controlled Russian oil areas are Latin America and the Persian Gulf. As a matter of fact, acceleration of producing operations in these regions is already under way as the petroleum needs of the United Nations grow. Reports on production show increases in Venezuela, Mexico, Trinidad, Colombia and Peru, the principal Latin-American exporting countries, this year and these increases will doubtless continue as the capacity to transport the oil improves. Civilian demand in all Western Hemisphere countries which are not self-sufficient has been curtailed by the war and consequently there is a waiting market ready to absorb large increases in Latin-American production as transportation facilities become available.

Reserves in all the above-mentioned countries are expected to be expanded with a wide-scale resumption of exploration activities. Despite a reduced campaign Colombia has witnessed three new discoveries in the past 2 years which promise a large increase in its production. Two of these will entail the construction of pipe-line outlets before the oil can reach market. In addition to such pipe-line construction, the Caribbean area will also experience an increase in refining capacity. This is assured in Venezuela where an agreement on the part of the companies to expand capacity from 72,000 bbl. per day to 192,000 bbl. per day accompanied the adoption of a new petroleum law. While these benefits will be limited principally to those countries which encourage foreign capital they are also potentially available to others which have so far excluded it.

TABLE 2—CONTROL OF WORLD PRODUCTION IN PRINCIPAL COUNTRIES

Country—	1940 production	Controlled by— Exclusively	Principally	Partially
United States	1,351,800,000	.....	U.S.	Others
U.S.S.R.	212,900,000	State	.....	.....
Venezuela	184,800,000	.....	U.S.	Others
Iran	78,600,000	Others	.....	.....
Netherlands East Indies	60,800,000	.....	Others	U.S.
Rumania	43,200,000	.....	Others	U.S.
Mexico	40,400,000	.....	State	U.S.-Others
Colombia	26,100,000	U.S.	.....	.....
Iraq	25,700,000	.....	Others	U.S.
Argentina	20,500,000	.....	State	U.S.-Others
Trinidad	20,200,000	.....	Others	U.S.
Peru	13,400,000	.....	U.S.	Others
Canada	9,000,000	.....	U.S.	Others
Burma	8,000,000	Others	.....	.....
Bahrein Island	7,100,000	U.S.	.....	.....
Sarawak, Brunei	7,000,000	Others	.....	.....
Saudi Arabia	5,400,000	U.S.	.....	.....
Egypt	6,100,000	Others	.....	.....

Persian Gulf Prolific

The expansion of the Persian Gulf area, known as the world's most fertile hunting ground for new fields, will probably be as great or greater. Anglo-Iranian Oil Co., Ltd., with a half dozen proven fields on its 100,000-sq. mi. concession in western Iran now is the dominant factor in the Persian Gulf area but American companies are also factors and potentially important ones. Standard Oil Co. of California and Texas Co., through jointly owned Bahrein Petroleum Co., which has the oil rights on 300 sq. mi Bahrein Island, and California Arabian Standard Oil Co., which has 160,000,000 acres under concession on the Arabian mainland, are most prominent. Substantial production has been developed on Bahrein and a refinery, with an original capacity of 25,000 bbl. daily, has been erected. California Arabian has two fields in Saudi Arabia, a small refinery and a pipe line. In addition Gulf Oil Corp. is coowner with Anglo-Iranian in Kuwait Oil Co., Ltd., which has the sole rights to the development of the Sheikdom of Kuwait where a number of wells have been completed and substantial reserves reported to total several billions of barrels have been developed. Iraq Petroleum Co. in which American oil companies have about a 25 per cent interest has also developed large prospective oil re-

American equipment and operating methods are standard practice in this Colombian field where a tank-battery site is being graded

serves on Qatar Peninsula on the Arabian mainland. Report of the construction of an entirely new refinery in this area has been published. Not only will this region be called upon to supply the expanding markets which it formerly served but it will undoubtedly also fall heir to some of those markets which had been supplied by the East Indies at least until rehabilitation of the latter is completed.

Rehabilitation of the Far East fields will be undertaken as soon as the East Indies are regained. The military forces of the United States have prepared service branches which will be qualified to move in immediately after the Japanese are expelled and undertake the reconstruction of the fields and refineries. The two large producing companies in the Far East are Shell and Standard-Vacuum, the latter being owned equally by Standard Oil Co. (New Jersey) and Socony-Vacuum. Standard-Vacuum produced about 25 per cent of the Netherlands East Indies oil and Shell the balance. Shell also owns the production of Brunei and Sarawak, British controlled areas in north Borneo. A potentially important factor in the Far East is N. V. Nederlandsche Pacific Petroleum Maatschappij, also owned by Texas and California Standard, which found "encouraging prospects" on its extensive concessions in Sumatra and Netherlands New Guinea before the invasion.

Prospects Elsewhere

This brief survey of the world's major producing regions omits Soviet Russia where large reserves are known to exist in the Ural-Volga and North Central Siberian areas as well as the Caspian basin and where new discoveries have recently been reported but which have been pretty well concealed from foreign eyes. Other important areas are also omitted such as Hungary and Austria, where new discoveries indicate a possibility that oil-hungry western Europe may yet develop adequate sources of supply; Rumania, western Europe's principal producing country which may witness a revival under more liberal regulation; China, which is developing fields under the stress of war and which will probably be receptive to American oil capital; India and Burma, which have produced substantial volumes of oil though only fractionally explored; Canada, with the hundreds of billions of barrels of oil locked in the Athabaska sands; and Egypt, where millions of acres are held under exploratory permit by United States and British oil companies. Though incomplete, this survey does indicate that there will be plenty of oil for the world for years to come. Already known resources are sufficient to supply demand at its current rate for 40 years. With only a small fraction of the world explored, yet-to-be-discovered reserves will prolong the world supply for many years.

The presence of a number of companies, representing commerce-minded nations, in the world picture provides assurance in itself not only that adequate supplies will be available tc all nations but that those supplies will be available at reasonable prices established on the basis of competition and not regulated through cartels. The very independence of the companies involved, competing as they are for both supplies and markets, provides the best assurance that the world will continue to receive ample quantities of the "essential fuel of peacetime" at economical prices.

Natural Gas Jurisdiction

(Continued from page 89)

5. Surveys and determinations of natural-gas supplies and reserves, the determination of the economic feasibility and adequacy of transportation facilities for the delivery and utilization of such natural-gas supplies.

Priorities and Certificates

Recognizing that the above responsibilities of the two agencies must be exercised during the war period with primary regard for meeting the war requirements and in order to secure a full measure of cooperation and coordination in the exercise of their respective responsibilities as above outlined under Sections A and B, the following arrangements will continue to be observed:

1. In the consideration of applications filed with them, WPB and FPC will freely interchange information and so conduct their investigations as to eliminate duplication of effort and secure maximum efficiency of the staffs of both agencies. Joint conferences with applicants may be held whenever such action is desirable to clarify the procedure in connection with or expedite the disposition of such applications.

2. With respect to the exercise of the commission's authority under Section 7 of the Natural Gas Act, as amended, it is understood that during the continuance of the war, action will be taken and orders will be issued by the commission only after prior consultation with WPB to make certain that any proposed facilities are essential in the war effort, to assure that materials can be made available therefor and to make certain that, in the case of proposed abandonment of facilities or services, the abandonment is consistent with the war effort.

3. With respect to any matters under consideration by WPB involving the construction, extension or abandonment of natural-gas pipe lines which require the approval or certification of FPC, under the provisions of the Natural Gas Act, as amended, it is understood that during the continuance of the war, action will be taken and order will be issued by WPB only after prior consultation with FPC, and when preference rating certificates and allotments of materials are issued by the WPB in such cases they will be accompanied by a statement that the issuance is upon the condition that applicant will promptly take all steps necessary to comply with any applicable requirements of the Natural Gas Act.

DEATHS

Walter A. Jones, 69, manager of the Michael A. Benedum oil interests in Ohio for several years, and former chairman of the Pennsylvania Turnpike Commission which constructed the $70,000,000 superhighway across Pennsylvania, died September 3 at Washington, D. C., He was an executive in the eastern glass industry, and in 1940 unsuccessfully opposed Sen. Joseph F. Guffey for the Democratic nomination in Pennsylvania.

Wlliam Ellsworth Sheats, 78, former employe of Independent Refining Co., Oil City, Pa., died recently.

George C. Hill, 50, who retired August 31 as cashier of the Standard Oil Co. of California, died September 12 at his home in Oakland, Calif.

John Stanley McElfresh, member of the manufacturing committee of the Socony-Vacuum Oil Co., Inc., and executive in charge of all eastern refining operations for the company, died late last month in his office in New York. He was 50 years old. Mr. McElfresh joined the Vacuum Oil Co. on September 1, 1910, at Olean, N. Y., where he was born and educated. He had been with the company without interruption for 33 years. Starting at Olean, he was shifted in 1917 to the Paulsboro refinery, where he served as wax division foreman and assistant superintendent. In 1931 he was made superintendent of the refinery. In 1934 he was transferred to New York, as assistant to H. F. Abrams, and upon Mr. Abrams' retirement in 1939 Mr. McElfresh became a member of the committee.

Lynn M. Davis, 47, foreman for Tide Water Associated Oil Co. at Mexia, Tex., died in that city September 10. Mr. Davis joined Magnolia Petroleum Co. in 1919, following his discharge from the Navy. In 1924 he began work for Simms Oil Co. In 1935 Simms was taken over by Tide Water and Mr. Davis remained at Mexia as foreman until his death.

Harry W. Smith, oil operator of Corsicana, Tex., died at his home September 14.

Down NORTH

ON THE CANOL PROJECT

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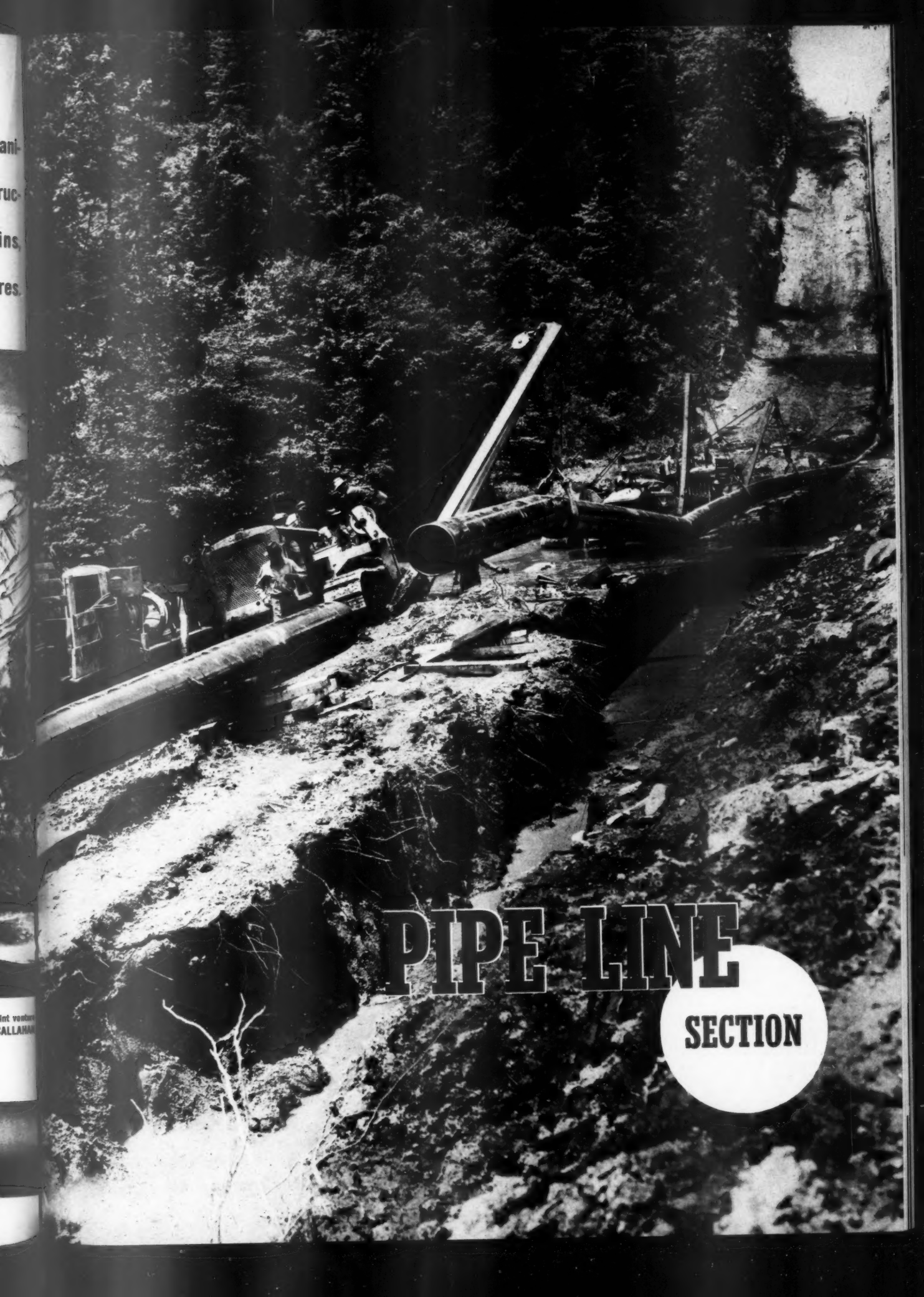

PIPE LINE
SECTION

THE PIPE

*by W. R. Finney**

Postwar uses for WEP 24-in. and 20-in. lines are considered in relation to tanker competition and possibility of conversion to natural gas service. Radical innovations in pumping equipment and construction of stations are

DURING the past year the pipe-line industry, working in close cooperation with government agencies, has completed a construction program that will stand as a record for many years. This represents a huge outlay of capital on the part of the individual companies and the United States Government, and is a noteworthy contribution to the war effort.

The achievements of the industry have been made possible by the ingenuity and experience of the oil men, matched with the urgent desire of government representatives and military leaders to deliver more petroleum products where they are vitally needed. The pipe-line industry's outstanding job was the completion last month of the 24-in. crude oil line from East Texas to New York and Philadelphia. This is being followed by the 20-in. products line from Gulf Coast refineries to New York, which will be in operation by the end of this year.

These projects, with completion of the 20-in. line, will deliver 750,000 bbl. per day to the East Coast—approximately one-half of the normal requirements. This will release many tankers for important use elsewhere which will help end the war in the shortest possible time.

With victory in sight, many people wonder what will become of the two big pipe lines. This is difficult to answer, but estimates of the operating cost of the 24-in. line go to show that this crude-oil carrier can compete with the large modern tankers that will be used in the Gulf Coast-Atlantic Seaboard service. This means that the 24-in. line will probably remain in crude service after the war. The outlook for the 20-in. products line is a little different, however. The estimated cost on the lower volume appears higher than tanker charges, so it is doubtful that this line can meet competition from the ocean carriers. The 20-in. line might be converted to transporting gas, but if any such arrangement is worked out it may be desirable to leave the pump stations in place so the line could be converted back to refined products, if necessary.

So much for existing pipe lines and their prospects. What is going to be the trend of pipe-line design and construction in the future? The study and experience of the past year might allow us to draw certain conclusions.

Trend of Design

The outstanding success of individual pipe lines in increasing deliveries through the old lines by various means has proved some fundamentals that might well be a guide for future design. These have included higher operating pressures, more efficient station practice and the removal of bottlenecks in the system. A number of lines have increased capacities as much as 25 per cent, while those that have installed intermediate stations are delivering 50 per cent more than before.

In this connection, the design and operation of the 24-in. line has proven the advantage of large diameters which lower the original investment per barrel and make possible a drastic decrease in operating cost. It is probable, therefore, that postwar pipe lines will be larger than the majority of those now in service.

All lines that are going to be in service any length of time undoubtedly will be welded throughout their entire length and placed several feet below ground, which will tend to maintain even temperatures and avoid damage from heavy rains. They will be protected against external corrosion wherever necessary, and the buried line minimizes the chance of interference from outside causes. These lines will be of large diameter, such as 16-in., 20-in. and 24-in., with the actual limitations on size decided by the mills which make the pipe. The walls will be thinner and more uniform because of higher-grade steel and improved pipe-making technique.

Leading engineers are convinced that the factor of safety can be as low as 2 compared to the old standards of 3 or 4. Some safety factor is necessary to protect against surge pressures. New stations will probably use centrifugal pumps for all crude and products, except those with high viscosities.

The pumps will be the single-stage, open-runner type which have proven so efficient and simple to operate. The main advantage of this type of pump is the freedom from pulsations and avoidance of damaging pressures. The power for the pump stations will be electrical where it is available at low cost, but with the many recent improvements in diesel engines it will be a question of which group retains the business. The station spacing will depend as always on the profile of the route, but stations will probably be farther apart than on the older systems. The fact that larger pipe with fewer stations lowers the operating cost, even after

*Coordinator of pipeline operations Standard Oil Co. of New Jersey.

LINE OF THE FUTURE

predicted as well as remarkable opportunities for automatic and remote control. Trends are indicated regarding inhibitors, liquid washers and pipe thickness and diameters. Helicopters may be transporting repair crews to underground stations in future operations!

Construction of WEP 24-in. crude oil line across Pennsylvania hills

the extra cost of the pipe is considered, has already been proved.

The big change in pipe-line practice in the future will be the adoption of automatic control at the individual pump stations. Considerable progress has been made in this direction by a number of companies and we look forward definitely to seeing stations so perfectly controlled by pressure, temperature, viscosity and volume devices that the operator's job will be one of observation rather than performance. This automatic control will go as far as opening and shutting valves, starting and stopping the units and making other changes in the station that have always been made by hand.

The gasoline lines built from now on will use inhibitors to prevent internal corrosion and to maintain, if not increase, the throughput. Whether or not the effect of inhibitors will become permanent on the inside of the steel pipe remains to be proved, but it is a fact that some inhibitors in use today create a slick, smooth surface on the inside of the pipe which increases the delivery factor.

In connection with inhibitors, provision must be made for better filters to remove the dirt, grease, mill scale and steel dust from new lines. The so-called hay tanks and screens using the batching process have not proved entirely satisfactory, so it probably will not be long before some ingenious engineer develops a continuous, self-cleaning type of filter that will remove all foreign particles as well as free water.

The crude lines will continue to use the admixtures such as gas recycling distillates, which increase the deliveries through lowering the viscosity and prevent adherence of paraffin on the inside of the pipe. The trend will be away from mechanical scrapers and toward liquid washers, and it may be possible to find an inhibiting agent that will improve the smoothness of the crude line. All of this will increase the rate of delivery.

The most progressive development in sight for pipe lines of the future will be in the direction of remote control. This has already proved satisfactory in a few locations, and we might well build a pipe-line system which would be completely controlled from one central point. This could be made effective by having single, motor-driven centrifugal units at each pump station that would be properly protected against high or low pressure and damaging temperatures. This single pump could be set on a bypass with a check valve in the main line, so that when the pump was down for any reason the flow would continue at a lower rate through the line. The valves necessary could be controlled by volume and pressures making it unnecessary for attendants to be present continuously.

Underground Stations

This booster pump could be housed in a small, obscure building made of concrete below the ground. This would add to the safety factor and decrease the possibility of trouble from outside causes. It would require proper lighting and ventilation when men were actually working on the pumping unit. A number of such stations could be serviced by traveling repair crews who could fly the spare unit from some central warehouse to the station in trouble. This duty might fall to the helicopter type of plane which will no doubt be popular after the war.

The control and communication cables for the pumping units along such a pipe line would be laid in the same ditch as the pipe itself, all of which would allow dispatching the throughput and controlling pumping operations from one central point. The delivery points from such a line would require more equipment and other types of control apparatus, but it could all be worked out so any particular type of gasoline moving through the line could be placed in a designated tank.

The advantages of remote control stations are many. First, it will probably prove to be the safest and most satisfactory way of moving petroleum products through a pipe-line. Second, it will simplify the difficulties of batching different products and reduce the amount of contamination. This has already been proved, as automatic control can be timed exactly so as to give sharper cuts, whereas hand-operated valves and pumps do a considerable amount of mixing that seems unavoidable. Third, the net result of the remote-control pipe line will be lower costs and better service. It will require fewer men along the line but they will have to be more highly trained. There is no doubt that the pipe line of the future will move larger volumes in the most efficient way with a resultant low cost which will allow it to compete successfully with other forms of transportation.

National Pipe-Line Program for Increasing Shipments to East Coast

by Henry D. Ralph

WASHINGTON, D. C. — Two years of wartime emergency in the transportation of oil have redrawn the pipe-line map of the United States and caused the greatest activity in pipe-line construction in the history of the country.

Through the teamwork of industry and government, two of the largest pipe lines in the world have been engineered and laid in record time, and dozens of older lines have been reversed, converted, enlarged, extended, and linked up into new networks and for new purposes.

For the first time we now have a whole network of through trunk lines carrying crude petroleum and petroleum products from the producing areas of the Southwest and Middle West to the large consuming areas of the eastern seaboard, whereas before the war only a few crude lines made the through connection and their deliveries were less than 5 per cent of total requirements in the area. Within a few months these new systems will be delivering more than 40 per cent of the prewar consumption rate which formerly was supplied almost entirely by ocean tankers.

To accomplish this required a revolution in the pipe-line industry. Lines which formerly served the individual uses of their owners were turned over to wartime national service. Some were physically uprooted and relaid hundreds of miles away. New sources of crude had to be found for refiners, and new supplies of products for marketers. The entire network thus created operates much as a unit with supplies and destinations determined by over-all conditions rather than by individual company desires.

Remaking the pipe-line map required a score of separate "projects," but all for the same purpose—to get more oil to the eastern seaboard and supply crude to refineries in the Southwest to replace that diverted from them to fill the new and rearranged lines. Many of these projects seem rather isolated when considered individually, but they all fit into a master plan worked out by industry committees and the Transportation Division of the Petroleum Administration for War.

Most spectacular of all the projects were the Big Inch crude line from East Texas to New York, and its companion Little Big Inch products line which paralleled it most of the way. These lines are owned outright by the Government in their entirety, being responsible for the biggest portion of the total expense of the program, are operated by the Government through agency contracts with the industry, and constitute entirely new and complete oil-transportation systems which probably will be continued in operation after the war. But a great deal more general planning, technical engineering, and economic adjustment were involved in the series of smaller projects that required locating used pipe and hooking up parts of several lines into a new system.

Pipe Lines for War

The wartime pipe-line program started 6 months before Pearl Harbor, in the summer of 1941 soon after the Office of the Petroleum Coordinator was established. An industry committee studied the problem of diversion of tankers from the Gulf-North Atlantic run and recommended that the industry form its own corporations to build and operate a 24-in. crude line from East Texas and a 16-in. products line from Wood River, Ill. However, a priorities system was already in effect, and materials could not be obtained for this construction. Immediately after the outbreak of war, industry committees again tackled the problem, and a general conference of pipe liners in Tulsa in March 1942 outlined a series of projects for new and converted pipe lines to do the work formerly done by tankers.

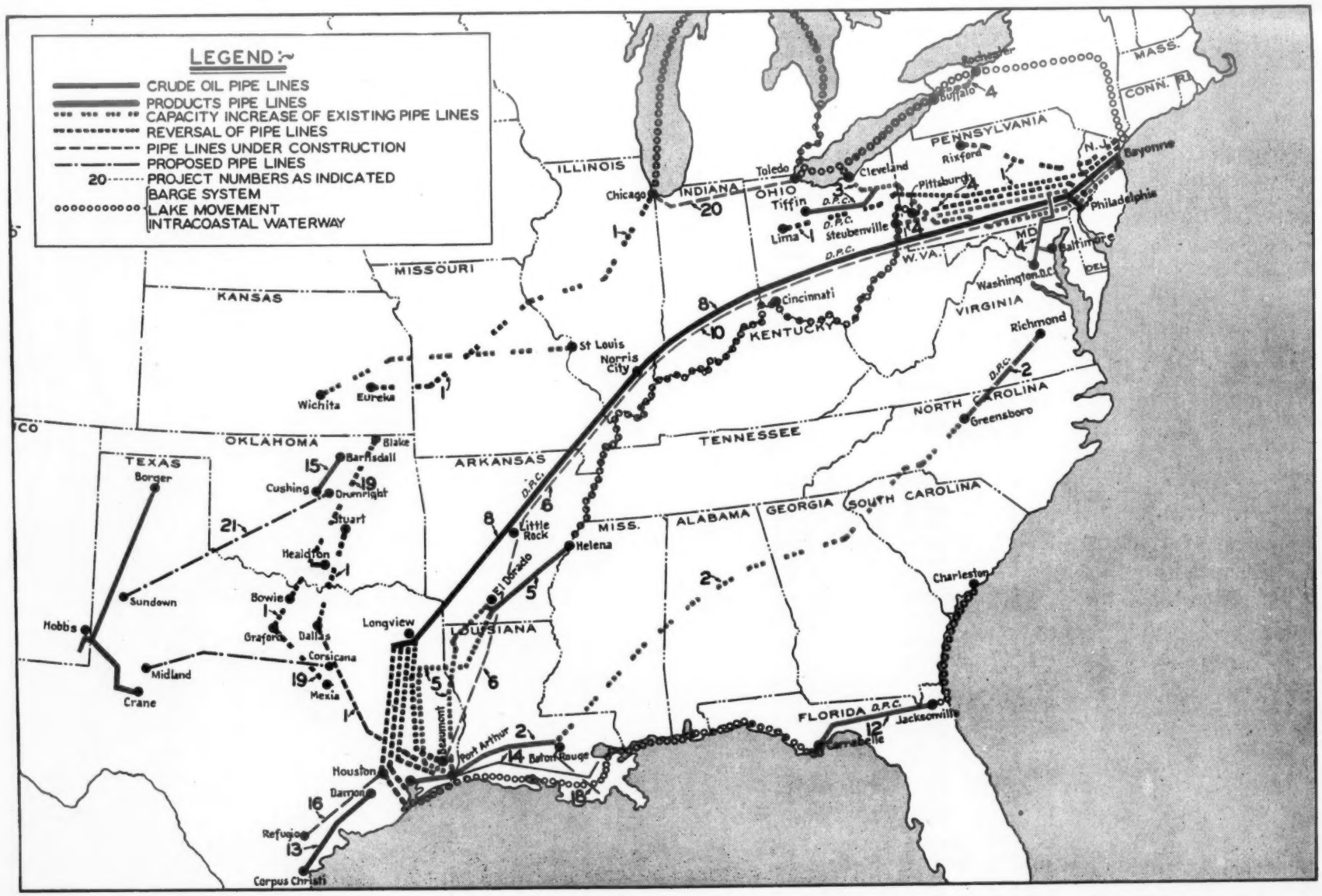
A comprehensive review of pipe-line construction required for increasing the flow of crude and products to the East Coast has been prepared by the author with the assistance of John E. Boice, senior transportation engineer, Transportation Division, PAW. This presents data on routes, lengths, diameters, capacities and costs for revamping old systems and building new lines to meet war needs since Pearl Harbor.

These projects became the basic plan followed by PAW, though it was not possible to carry out every project exactly as originally planned. Difficulties in getting allocations of materials and delivery of equipment caused many delays, but the entire program was pushed vigorously and is now nearing completion.

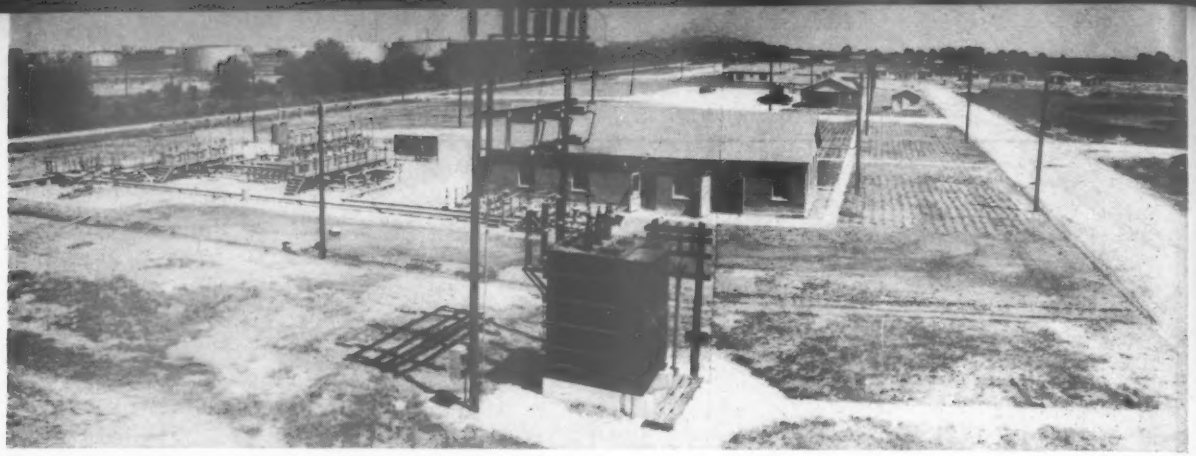
This pipe-line program is an excellent example of cooperation between government and industry. Most of the planning and engineering were furnished by the industry, but the Government checked, supervised, and coordinated. The majority of the projects were financed entirely by the companies concerned, and in many cases the industry located second-hand pipe and equipment, thus relieving the demand for new steel and fabricating facilities.

However, a number of the projects were of such doubtful postwar value that industry hesitated to make the necessary investment, and these were readily financed by the Government through the agency of Defense Plant Corp. DPC owns these projects, but has made operating contracts with private oil companies to operate the lines. An exception is the Big Inch, where War Emergency Pipelines, Inc., formed by several major oil companies, operates the line as agent for Defense Supplies Corp. which owns all the crude carried and which directs both sources and disposition of the oil through a detailed monthly operating schedule. Operation of the other lines is subject to general supervision by the Government; the operators submit proposed schedules of movement which PAW usually approves as routine but it can make requests for changes if desired.

(Continued on page 223)



Map shows scope of extensive projects for increasing crude and products movements northeastward since wartime withdrawal of ocean tankers



Port Neches terminal, general view—1,000-kva., 66,000/2,300-volt "unit-type" substation in foreground; station manifold and metering equipment at left; pump-house; terminal office and laboratory building above left end of pump-house; sample storage house at right of office; employes' cottages beyond latter; station tanks out of picture at right; Texas Co.'s Port Neches works in left background

Bayou Attains High Capacity In War Emergency

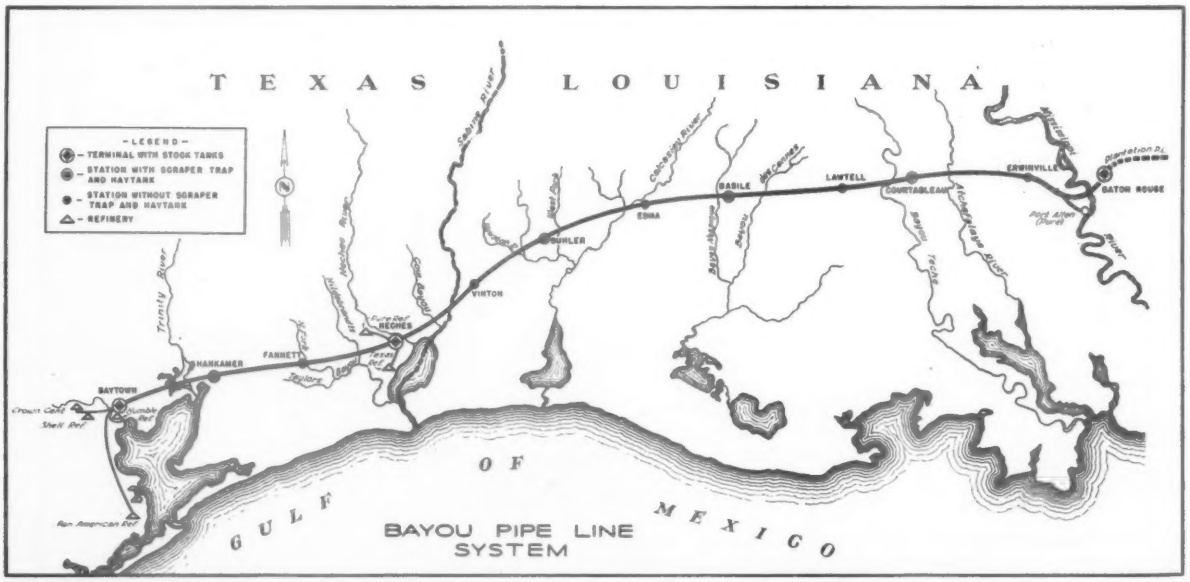
by H. H. Anderson,* C. E. Dolhonde† and L. J. Rittiner†

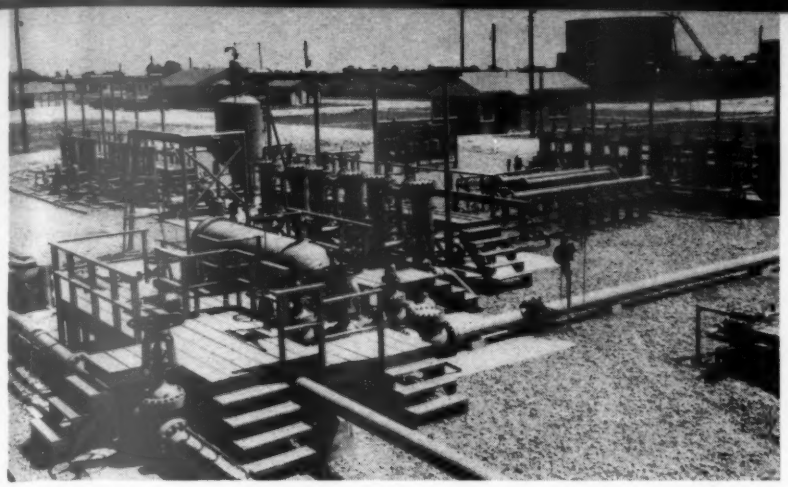
AMONG oil's war-emergency projects, the Bayou Pipe Line System is unique in many respects. It is the largest of the privately financed emergency pipe lines—an $8,000,000 asset in which the outlay for new materials was limited to about $1,000,000. It is an essential new products line for which most of the major equipment and pipe were salvaged from less essential old crude lines.

Despite the headaches it brought while "aborning," this second-hand "baby" has made the newest prewar lines — with their galaxy of special pumps and gadgets — look to their laurels. Many of Bayou's electric pumps were built in 1927 for crude service, and already had been tagged for the junk dealer, but the 183 miles of 10-in. line to Baton Rouge, La., from Port Neches, Tex., has delivered 64,100 bbl. of gasoline in 24 hours, and the 68 miles of 8-in. to Port Neches from Baytown, Tex., moves 40,500 bbl. regularly.

From 12 locations in four states Bayou's builders assembled 300 miles of old pipe, most of which had carried sour crude for years, and 35 miles of which was recovered from

*Vice president, Shell Pipe Line Corp.
†Engineers, Shell Pipe Line Corp.





Port Neches terminal, station manifold—hay tank filter and scraper traps in foreground; meters on Texas feeder, Pure feeder and Baytown 8-in. line at left and right of hay tank; meter calibration tank above hay tank; control board at right of calibration tank; tank manifold and totalizing meters at right; station utility building in center background; terminal office and laboratory and sample storage buildings in left background

abandoned wells. Yet so carefully was that pipe relaid and pressure-tested that only one rupture has occurred during 6 months of operation at 800-lb. per sq. in. station pressures. In fact, the total loss of motor fuel during the delivery of 400,000,000 gal. into Baton Rouge — including losses from all connected shippers' and receiving tanks—has been less than 0.35 per cent.

Particularly satisfactory has been the low contamination between adjacent batches of products received at Baton Rouge. Although four streams merge at Baytown and three at Port Neches—and without the use of liquid or mechanical separators between batches—the quantities of resultant admixture of products at Baton Rouge average less than 270 bbl. per change. On normal 150,000-bbl. batches of premium gasoline the quantity degraded to housebrand is only 0.36 per cent.

Not only its unprecedented use of second-hand material but also its patriotic private financing has won distinction for Bayou. The $8,000,000 needed for construction was subscribed by Humble Pipe Line Co., Texas Pipe Line Co., Shell Pipe Line Corp., Pan American Pipe Line Co., Pure Transportation Co., and Crown Central Pipe Line & Transportation Corp. The legal structure is a joint ownership venture of these six common-carrier pipe-line companies, each of which owns a proportionate undivided share in each facility. This joint-ownership venture is neither a partnership nor a corporate association. While the physical facilities are operated as a single pipe line by one of the owners (Shell) under contract with each of the other five, the Bayou system is treated for business purposes as six parallel pipe lines owned by six competing companies—each of which has published a separate ICC tariff to apply to its share of the system's capacity.

Port Neches terminal, station pump-room—three 3-stage, 6-in., 3,600-r.p.m. pumps in pump-room; vaportight wall separates motor-room at left; gage and automatic-control panel at far right is visible through windows from motor starting-equipment room at rear

Basile station, motor-room—two 500-h.p. 2,300-volt, 3,600-r.p.m. motors and new style 2,300-volt motor starting and distributing panels. Ventilating system in ceiling

When OPC's Temporary Joint Pipe Line Committee conceived Emergency Project 2 in April 1942, it proposed that a 60,000-bbl. per day line should be built from the Beaumont-Port Arthur area into Baton Rouge to feed the Plantation Pipe Line in lieu of the coastal tankers which had been diverted to other services. The committee proposed that half of the daily supply could be obtained from refiners in the Houston-Texas City area through exchanges or trades. However, the fact was soon developed that about two-thirds of the supply must physically originate in the latter area; hence the decision to build also a 37,000-bbl. line east from Baytown.

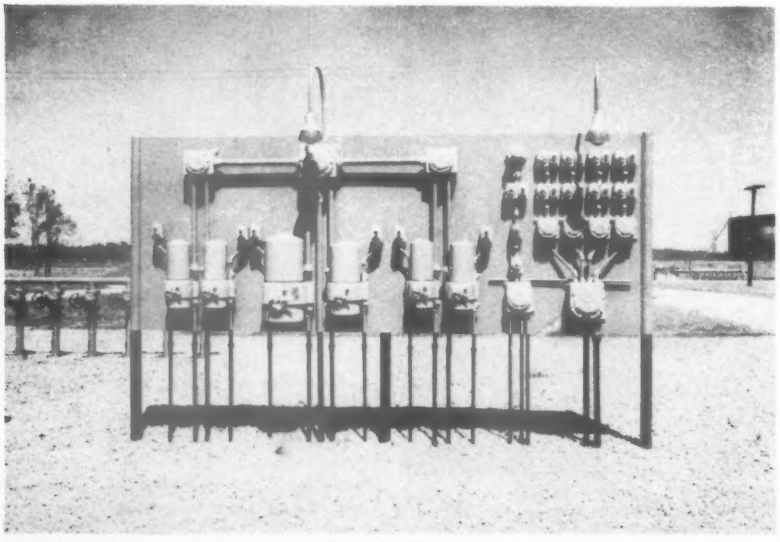
Late in May 1942 Shell Pipe Line Corp. was selected by the subscribing companies to design and construct the Bayou system and to operate it for the duration. Then Shell Pipe

Basile station, operating area—buildings right to left are pump house, pump-house office, utility and garage building. In foreground left to right are sump pump, hay-tank and scraper traps, twin basket strainer, automatic control valves. This layout is typical of four stations on 8-in. and 10-in. lines

Line's president, T. E. Swigart, assisted by W. S. Bell of his legal staff, took the lead in concluding the unique plan and agreement under which the work was to be undertaken. Shell's vice president, H. H. Anderson, and its chief engineer, D. H. Lewis, set about to organize the work of design and construction. In this they were assisted principally by W. H. Shelley, who was placed in charge of line construction, and by C. E. Dolhonde, who engineered the design and construction of the stations and terminals. All business was transacted in the name of Shell Pipe Line Corp., and the financial and accounting features were under the direction of Shell's treasurer, E. H. Mueller.

The routing of the new lines was influenced by three factors: (1) the saving of survey time to be made by paralleling existing lines, (2) the saving of protective coating costs to be made by avoiding corrosive soils, and (3) the limitations imposed by the terrain across the Atchafalaya Floodway. The surveys and rights-of-way drawings were prepared by K. R. Allen, Shell's chief draftsman, and his crews of surveyors and draftsmen. Purchase of rights-of-way was directed by A. E. Groff, Shell's secretary, and his assistants in the rights-of-way and claims section, C. C. Clothier and G. R. Woolf. It should be recorded that complete cooperation was given by all state, county and parish officials in the solution of rights-of-way and other problems of line construction.

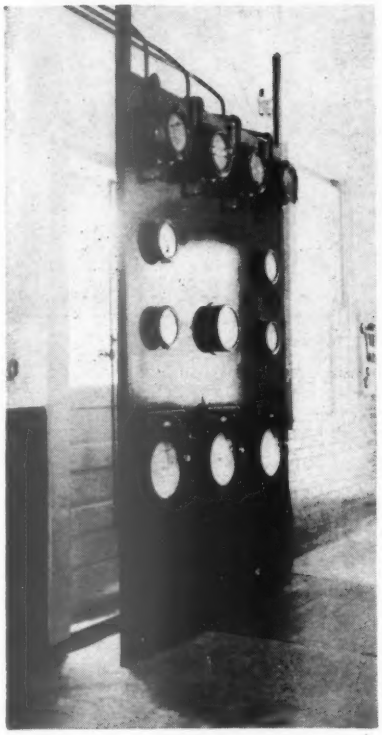
Baytown terminal, manifold pump control board—typical also of layout at Port Neches; left to right are: two secondary sump-pump starters, calibration-pump starter, primary sump-pump starter, two secondary sump-pump starters, station emergency stop-button, sump-tank signal and howler (immediately above), and four tank-farm booster pump running signals



Salvaged Equipment

To acquire the pipe as well as other needed old and new materials was the job of Shell's purchasing agent, J. B. Thompson, and his patient coworkers. S. B. Dean had charge of materials in the field. Theirs indeed was a hapless job. Old pipe lines, abandoned for years, were sought out for salvage. Other lines, still in use but not essential to war purposes, were bought up and reclaimed. From the Osage to the Gulf and from the Pecos to the Mississippi, "take up" crews went to work. As fast as the ditching machines laid the old lines bare, workmen cut the pipe into convenient lengths and fed it to cleaning machines where whirring knives scraped off the crust of years. Thence it was loaded into cars and moved to coating plants and to the job. However, the problem of getting pipe was child's play compared to that of buying welding rod, welding flanges and steel fittings. Mr. Thompson and his boys could usually be found in the dilemma of patriotism or priorities.

The 10-in. line from Port Neches to Baton Rouge was laid by I. C. Little Co. with the exception of a few miles laid by Williams Brothers. The 8-in. segment as well as the feeder lines to Baytown from the Crown, Humble, Pan-Am and Shell refineries were laid by O. R. Smith Co. Except for a stretch of 65 miles between



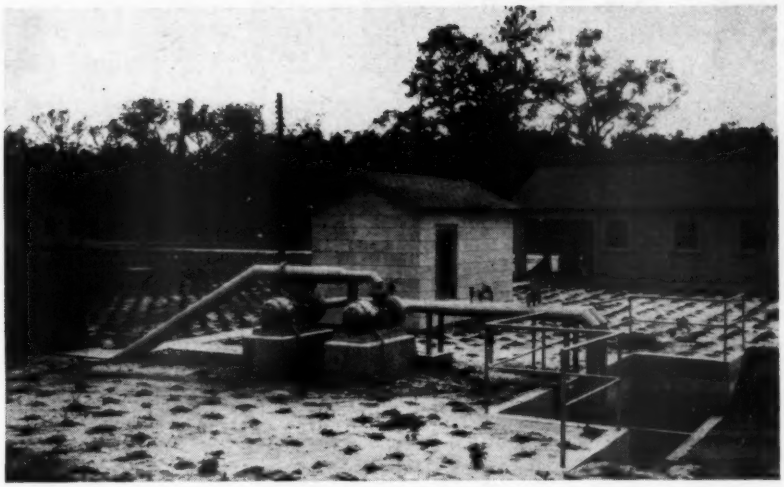
Basile station, pump-room—typical gage and automatic-control panel. The four Mercoid switches at top and automatic controllers at bottom are those shown in accompanying diagram. In center section are four pressure gages flanking station clock. Note access door behind panel

Toomey and Elton, La., the pipe was shop-coated with Somastic by Industrial Engineering Co. The 65 miles, all 10-in., was field-coated with felt and Barrett enamels by the laying contractor. The highest point on the lines has an elevation of only 61 ft.; so much of the pipe of necessity was laid in the soggy soil of cypress swamps and rice lands.

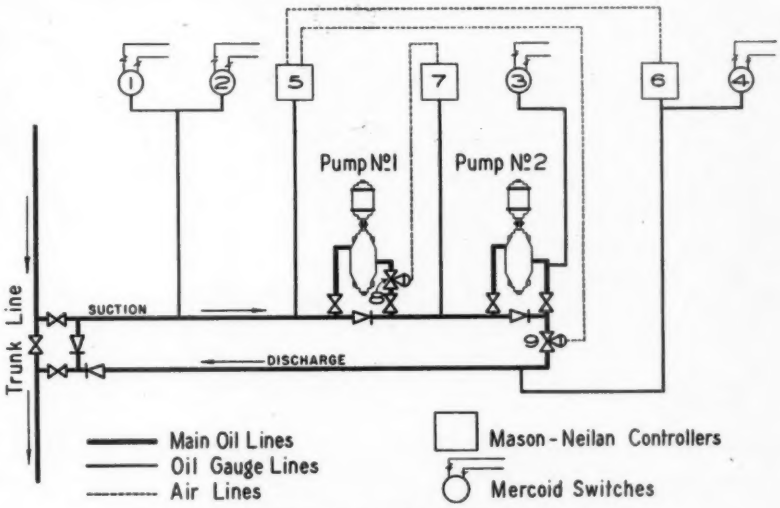
The lines cross many major water courses, including the Houston Ship Channel and the navigable Trinity, Neches, Sabine, Calcasieu, Atchafalaya and Mississippi rivers. Existing crossings at the Ship Channel and Neches River were purchased in place. However, new ones of extra-heavy pipe were laid under all other rivers, including dual 10-in. crossings under the treacherous Atchafalaya and the nearly mile-wide Mississippi. These latter were laid by I. C. Little so quickly that it taxed the credulity of Shell's inspectors. Innumerable bayous crossed en route won for the line its appropriate name. Each crossing was laid at least 3 ft. below the stream bed, and the use of extra-heavy coated pipe and welding sleeves avoided the need for river clamps.

Design of Bayou's 11 stations and terminals proved to be a nightmare for the engineers. Not theirs to flip

(Continued on page 116)



Fannett station, storm-water pumps—typical also of layout at Courtableau; necessitated by heavy rains and low elevations of stations



Automatic control and protective devices

1. *Low-suction-pressure Mercoid—Is adjustable from 0 to 300-lb. per sq. in. with the actuating element capable of withstanding 600 lb. per sq. in. Purpose is to de-energize motor circuits when station suction pressure falls below a predetermined amount (10 lb. per sq. in.)*
2. *High-suction-pressure Mercoid—Is adjustable from 0 to 1,000 lb. per sq. in. Purpose is to de-energize the motor circuits when the station suction pressure exceeds a predetermined amount (500-lb. per sq. in.)*
3. *High-case-pressure Mercoid—Is adjustable from 0 to 1,200 lb. per sq. in. Purpose is to de-energize the first motor circuit when the case pressure of No. 2 pump exceeds a predetermined amount (1,000 lb. per sq. in.)*
4. *High-discharge-pressure Mercoid—Is adjustable from 0 to 1,200 lb. per sq. in. Purpose is to de-energize both motor circuits when the station discharge line pressure exceeds a predetermined amount (835-lb. per sq. in.)*
5. *Suction-pressure-controller—Is adjustable from 0 to 200 lb. per sq. in., with actuating element capable of withstanding 600 lb. per sq. in. Purpose is to maintain a predetermined minimum suction pressure (30 lb. per sq. in.) by throttling the station control valve (9) in the station discharge line. An extra pressure-recording element is used for pressures in excess of 200 lb. per sq. in.*
6. *High-discharge-pressure controller—Is adjustable from 0 to 1,000 lb. per sq. in. Purpose is to maintain a maximum station discharge line pressure constant by throttling the main line control valve (9)*
7. *& 8. No. 1 Pump-case-pressure controller and valve—Is adjustable from 0 to 1,000 lb. per sq. in. Purpose is to limit indirectly the second pump case pressure to a predetermined amount (950 lb. per sq. in.) by limiting the discharge pressure of the No. 1 pump to an amount equal to the difference between 950 lb. per sq. in. and the total possible differential head of No. 2 pump*
9. *Station control valve—Is actuated by station suction and discharge line pressure controllers. Purpose is to throttle the station's discharge-line pressure and to synchronize pumping rates*

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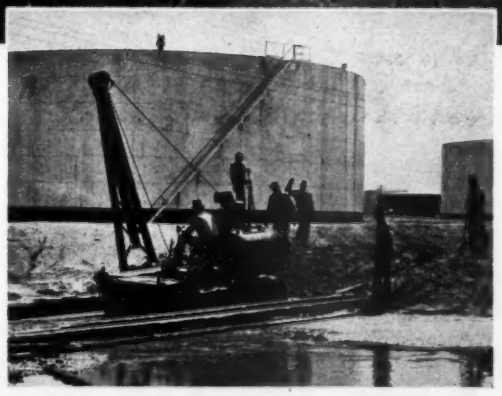

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the pages of equipment catalogs for this or that valve, pump or motor best suited to their purpose. Not theirs to prepare standard drawings of stations that could be built in quantities as needed. No, sir! Not on this job! Aided by E. C. Morris on electrical layouts, L. J. Rittiner on mechanical equipment and controls, and E. R. Page of Shell Oil on general arrangement, each station and terminal was separately designed around the old equipment found—second-hand stuff, castoffs of normal days which ran the gamut of variety in make, type and age. Construction of the stations and terminals was handled by L. E. Myers Co. on a basis of cost plus fixed fee contract.

Twenty-four available centrifugal pumps were found of five makes, sizes and vintages. These provided two units to operate in series at each station and a spare each at the two terminals. Fortunately, six pumps alike and a suitable spare were found for the three stations on the 8-in. line, and two sets (each approximately alike) of nine fairly new and eight old pumps were found for the 10-in. line. Most of the old pumps had been accumulated during a prewar program of modernization of Shell's West Texas lines, and the nine fairly new ones were dismantled for Bayou from three stations on Shell's East Texas line. Shell had just sold Project Five Pipe Line eight similar old 400-hp. units (pumps, motors and starting panels), so the supply of second-hand large motors and starters was not so plentiful for Bayou. It was necessary to borrow, dismantle and temporarily install six motors, 12 2,300-volt starting panels, and six secondary transformer and distribution panels that were later removed and replaced with new equipment.

Owing to the different characteristics of the two lots of pumps available for the 10-in. line, the series pairs developing 800 and 600 lb. per sq. in. respectively, the eight stations were spaced alternately about 27 and 19 miles. All intermediate stations on the 8-in. line and seven stations on the 10-in. are adjacent to state or United States highways. The two terminals were located conveniently on 40-acre tracts near Humble Oil's Baytown refinery and Texas Co.'s Port Neches works.

Terminal Facilities

The Baytown and Port Neches terminals were laid out to handle four products, with seven riveted-steel storage tanks at each terminal having total capacities respectively of 240,000 and 275,000 bbl. — floating-roof tanks being provided for the gasolines and cone-roof ones for the heavier products. The tank erector was Steel Tank Construction Co. All of the tanks are second-hand, being supplied by the Bayou owners or purchased from others. In one instance five tanks were made from the remains of four old ones. Because of soft soil, all tanks were set on concrete rings reinforced with the trimmings from the salvage tank sheets. Most of the tanks are arranged in pairs connected through remote-controlled booster-pumps which keep a constant suction head on the terminal stations. Small slop tanks to aid the cutting of batch ends without contamination are installed at Baytown, Port Neches and Baton Rouge. All other tankage at Baton Rouge is owned by Plantation Pipe Line Co. and that at Port Allen terminal on the Mississippi River, into which Bayou can deliver, is owned by Pure Oil Co.

At the nine intermediate stations it has been possible to eliminate working tanks because the electric motor-driven centrifugal pumps are provided with air-actuated automatic controls. These synchronize the pumping rates at all stations and thereby eliminate sympathetic "kickoffs" of other stations when a single one is shut down by an electric power interruption. These controls, which were made by Mason-Neilan, serve also to minimize the attention and labor required for hand-throttling of large gate valves, and—together with their companion Mercoid switches—

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they protect the pumping units during sudden changes of flow rate or pressure. A schematic diagram of the control and protective equipment at a single station appears in this article. Rube Goldberg proved that "necessity is the mother of invention," but Shell's engineers proved that a reliable automatic control could be assembled without many of the special devices heretofore thought necessary.

All piping manifolds are designed to minimize contamination in dead spaces and pockets in the lines. The effectiveness of this design has been demonstrated by results. Through the use of piston-type check valves, positive shutdown of a pumping unit or of an entire station is accomplished with stopping the trunk-line flow. It was planned to use plug-type valves throughout the manifolds, but, alas, "priority trouble" forced the use of second-hand gate valves in most cases, and even these in 10-in. and 8-in. steel 800-lb. test were hard to get. Station piping manifolds are insulated from the trunk-line by dielectric gaskets.

Scraper Equipment

While scrapers and filter-tanks are highly desirable on any products pipe line, they are absolutely essential on Bayou with its 250 miles of second-hand pipe which had accumulated the internal deposits of many years of sour-crude service. Scraper insert and receiving traps with Uni-bolt blanking plugs are installed at alternate stations, as is also a filter or "hay" tank of the newest Alco design. Owing to the necessary delays in delivery of these hay tanks, their function was meanwhile served in part by Wheatley basket-type twin strainers.

Pittsburg Equitable positive-displacement meters have been installed on all Bayou feeder lines as well as on the station suction headers at Baytown and Port Neches. The meters on the feeder lines record receipts into the system from individual shipper's refineries, while those on the suction headers take account of the floating effect of the terminal working tanks and record the total of all products leaving the terminals. Meter manifolds include two Moorlane basket-type strainers per meter, and a 1,000-gal. proving tank with accompanying pump and lines for meter calibration. A Foxboro orifice-type flow meter is installed at each station to determine instantaneous flow rates. An Arco Anubus continuous-recording gravitometer will be installed at each terminal and scraper station.

The floors of Bayou's pump houses and detached offices are set 3 ft. above natural grade, which plan allowed the pipe trenches to be placed below the floor line and yet kept open to the atmosphere through foundation-wall openings without the use of pits. It enabled the exterior piping manifolds to be placed aboveground, thereby affording easy access to all fittings, and minimizing the hazards of vapor accumulation as well as the ravages of corrosion. The elevated floors also prevent flooding of equipment during the frequent torrential rains along the Gulf Coast.

The station pump-house buildings are of solid brick, on concrete foundations, with wooden trusses and asphalt shingles. Gastight walls between pumps and motors, and the ceilings of the pump and motor rooms, are lined with Masonite. Fans exhaust air from both rooms to minimize the chances for explosion and fire. The station gage and automatic-control boards are in the pump rooms. The 2,300-volt distribution and motor-starting panels as well as the station secondary transformers and their panels are in the motor rooms. At six stations the panels finally installed are the newest General Electric metal-clad, reduced-voltage automatic type. At five stations the open-type panels salvaged from old lines are in use.

The detached offices for the station engineers are of wood-frame construction. They are lined with wallboard and, except at the termi-

(Continued on page 122)

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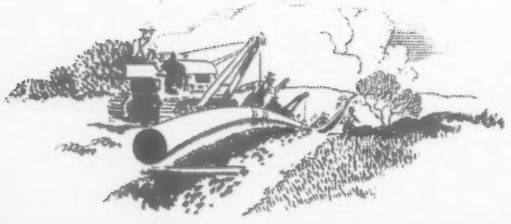
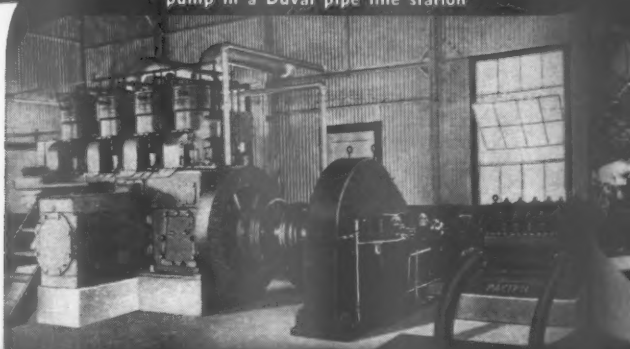
Four 6-cyl., 600 H. P. Clark "Angles", Canadian River Gas Co. pipe line station

Clark 400 H. P. "Angle" driving oil pump in a Duval pipe line station





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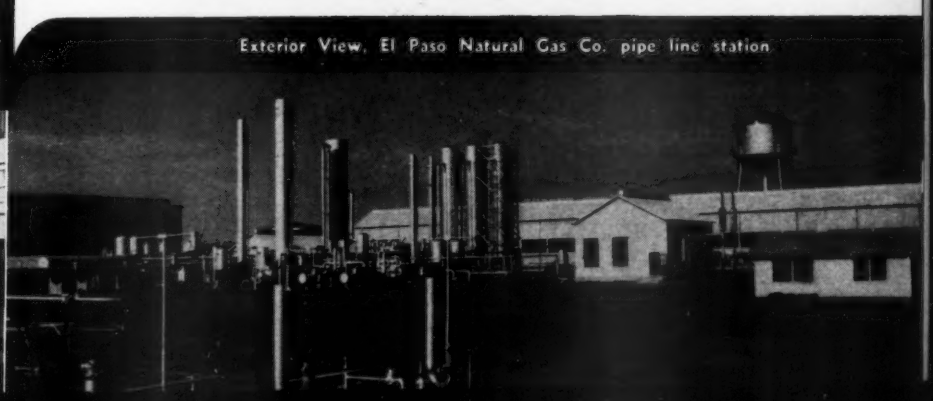
AFFILIATED COMPANIES: Dresser Mfg. Co., Bradford, Pa.; Pacific Pump Works, Huntington Park, Calif.; Bryant Heater Co., Cleveland, Ohio.

CLARK

600 H. P. "Angles" in an El Paso Natural Gas Co. pipe line station

Exterior View, El Paso Natural Gas Co. pipe line station



nals, are covered with asbestos siding. At the two terminals the exteriors are of brick veneer. All roofs have asbestos shingles. In these offices the engineers can get relief from the noise of the pumping units while using the intercommunicating teletypewriters or the local Bell telephones. Separated wash-room facilities and small storerooms are in the same buildings. Each operating group (comprising pump house, office and piping manifold) is compactly located for the operator to easily cover in the dispatch of his duties, and with the major and important items of equipment always visible. However, office, pumps, motors and starting equipment, and manifold valves are separated enough to provide a proper factor of safety.

At each terminal there is a brick-veneer building which contains a small general office, warehouse, analytical laboratory and washroom facilities. In the Baytown building, private offices are provided for the chief chemist and the division superintendent. The laboratories are equipped to make the usual analyses which control the acceptance of motor fuels, kerosene and No. 2 heating oil, although in practice such tests are limited to "spot checks" only. Near each laboratory is a wooden building where product samples are stored for reference purposes.

Wood-frame buildings erected at each station include a combination utility garage, work shop and supply storeroom, a water-tank house and employes' dwellings. The latter are essential because there is a shortage of housing in the defense industrial areas such as Baytown, Port Neches, Orange, Lake Charles and Baton Rouge, in or near which Bayou's stations are located. Four cottages and two twin garages serve the chief and three shift engineers at each of nine stations. At Baytown and Port Neches additional dwellings have been erected for the gagers, chemists, terminal supervisors and superintendent. Nine of the cottages were purchased and moved from Shell's dismantled East Texas line stations; the others, as well as the garages, were built new under subcontract by Arkmo Lumber Co. The new cottages have asbestos siding and asphalt shingle roofs.

Disposal of Water

Because of the locations of the stations it was necessary to drill a water well at each, and to provide for proper sewage disposal. Inasmuch as two of the stations are in low areas subject to flooding by backwater from heavy rains, the sites were enclosed by earthen dikes. At each of these, two motor-driven centrifugal pumps connected in parallel, with automatic controls, handle the disposal of storm waters inside the dike area. At two stations it was necessary to construct 100-ft. long entrance bridges from the highway.

Bayou is electric powered throughout, and all but one station is served directly or indirectly by Gulf States Utilities Co. Basile is served by Gulf States via the lines of Gulf Public Service Co., and Baytown is served by Houston Lighting & Power Co. Second-hand transformer substation equipment was available for only four of the 11 stations; for the others it was necessary to purchase Westinghouse three-phase unit-type substations, six with 33,000-volt and one with 66,000-volt primaries. Owing to the proximity of the Gulf States' service to the Bayou route, all 11 stations were connected by the construction of only 35 miles of new high line. Splendid cooperation was given by the power companies and Westinghouse in providing power service sooner than it was actually used. Bayou's total connected load is about 8,000 kw.

Dispatching of the Bayou system is handled from Shell's Houston office. This work relies on the communications system which was laid out by F. W. Littell. It comprises principally a continuous 24-hour teletypewriter circuit leased from American Telephone & Telegraph Co. The machines are of the tape type, and are operated by the dispatchers and station engineers. For emergency use, each station and terminal is connected by Bell telephone to the nearest

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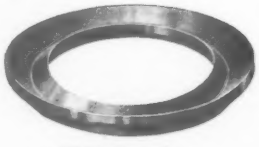

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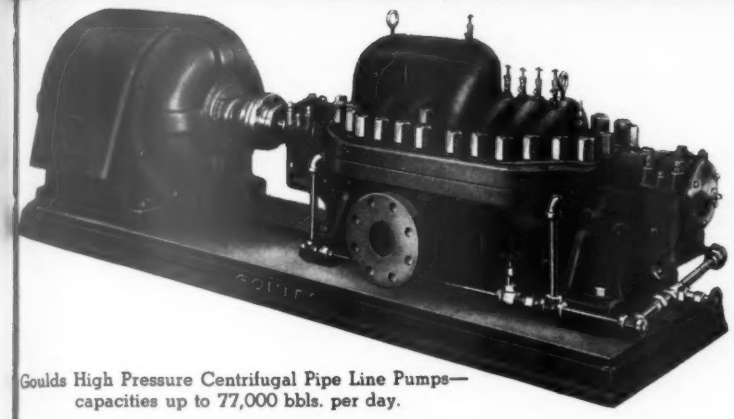

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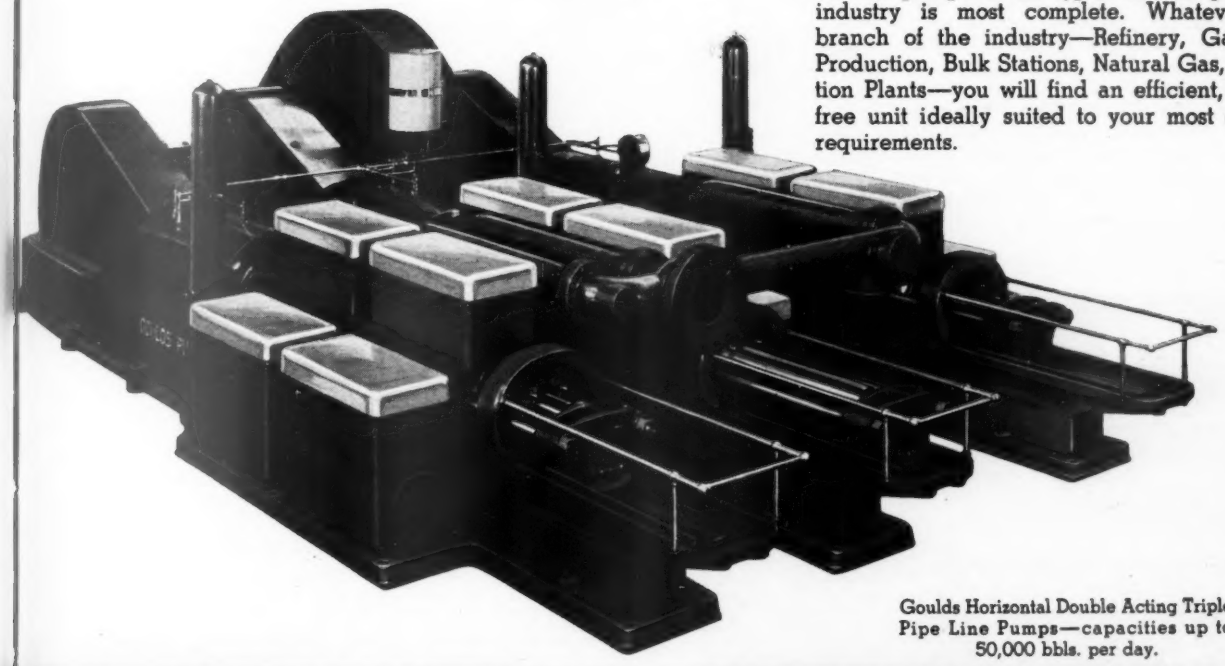

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town. A leased telephone circuit for administrative purposes connects the Houston office with the terminals at Baytown and Neches as well as the refiner's pump stations at Deer Park and Smiths Bluff. Other refiners' pump stations at Pasadena, Texas City, Baytown and Port Arthur are reached through telephone tie lines installed between Houston office switchboards of Shell and those refiners.

Construction progress on Bayou's stations and terminals was controlled by the speed with which needed material could be assembled. All efforts were directed to make the Baytown and Neches origin stations and Basile—midpoint on the 10-in. line—operable first. Pumping at Baytown was started on January 7 to test the pipe line, and at the other two on February 10 when daily pumpings to Baton Rouge of about 25,000 bbl. daily were commenced. The first oil reached Baton Rouge on February 15.

Pumping at each station was started with the bare minimum of wiring and piping essential to safe operation. At Basile and five other stations it was necessary to use the temporarily assembled 2,300-volt starting and distribution panels. These were placed in a shack adjacent to the pump house so that the new gear could be easily installed after arrival. The old panels proved to be so obsolete and incomplete that frequent station shutdowns resulted. Baytown and other stations on the 8-in. line were started with borrowed 400-hp. motors, most of which are still in service pending receipt of new ones on order.

Start of Operations

Hankamer, the second station on the 8-in. line, and Buhler and Courtableau, the "quarter point" stations on the 10-in. line, were started on February 15. This increased the daily deliveries to about 42,000 bbl. Starting of Fannett, the third station on the 8-in. line, and the four "eight point" stations on the 10-in. line, was delayed until late in March because every available valve and fitting had been purposely placed in the other stations. Due to failure of a second-hand pump, however, the last four 10-in. stations could be operated with only one unit each, which raised the daily rate to about 50,000 bbl. With the replacement of this pump and the operation of all equipment, the rate was increased to about 55,000 bbl. in mid-April.

Through going to a 44-hour work week in all operations, Shell Pipe Line Corp. was able to transfer from its crude-oil lines to Bayou about 120 experienced men who formed the backbone of its operating organization. This was fortunate for all concerned—Shell, the other Bayou owners and Shell's employes. These moves were handled by L. C. Geiler, Shell's personnel manager, and his staff.

After the pipe was laid and the station gate valves were placed, each section of line was water-tested by the operating men to about 900 lb. per sq. in. for 6 hours. This developed a total of 46 breaks, 10 on the 8-in. line and the others on the 10-in. The lines were perfect from the standpoint of field construction and welding, but the fault lay in the old pipe itself which split repeatedly in the lap welds with gaps ranging from 2 to 8 ft. in length. This testing operation proved to be one of the real headaches of the job, and four test crews grew web feet and canvas backs during several tough weeks amongst rice fields, swamps and bayous in the rainiest portion of a Gulf Coast winter.

After the line was made fluidtight and the first stations were turned over to the operating personnel, the latter's next job was to clean the inside of the pipe so that it would transport light commercial products without contamination. When a working crude-oil line is suddenly changed to products service, such cleansing is not difficult because the line is still wet. However, as in the case of Bayou, when products must be put through pipe which has been taken

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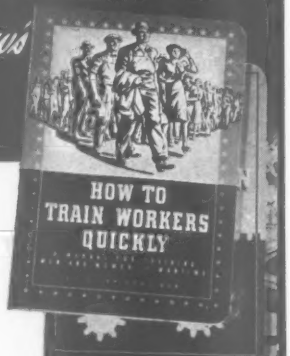

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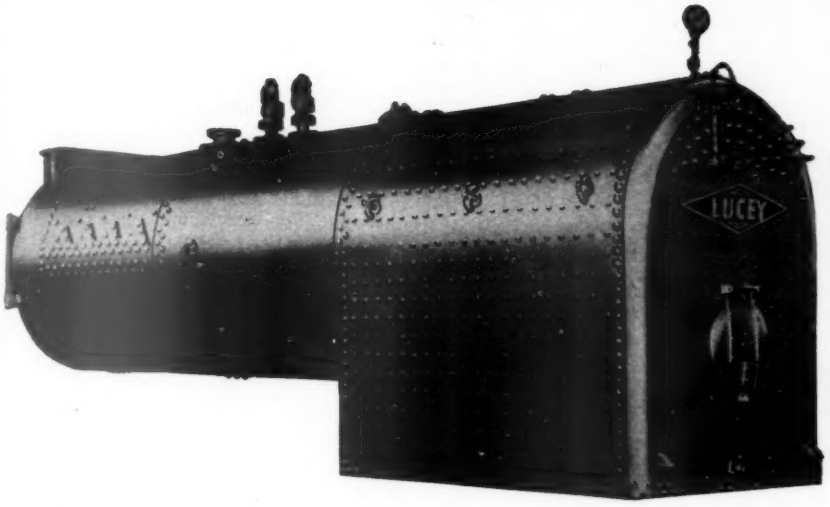

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150 Horsepower
250, 300, 350 Lb. Working Pressure

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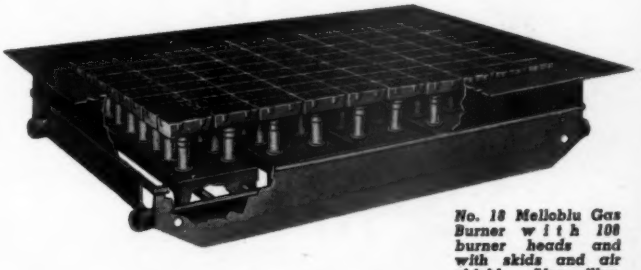
Large firebox—60"x72"x96" provides a heating surface of 178 sq. ft. and a furnace volume of 233 cu. ft. Total heating surface 1505 sq. ft. Greater burner space together with large furnace volume insure adequate combustion and permit efficient firing at 200 to 300 percent of the A.P.I. horsepower rating.

Seamless LUCEY firebox (patented) eliminates overheated and burnt rivets and leaky seams. 20" space between crown sheet and outside wrapper provides ample steam space. Good water circulation with 4" water space all around the firebox. Water volume—2310 gallons. Easy to clean.

LUCEY Boilers are constructed strictly to the requirements of the A.S.M.E. Boiler Code and can be furnished to meet the regulations of other countries.

"MELLOBLU" patented low pressure gas burners—quiet, non-pulsating and economical—operate on gas pressure as low as four ounces.

These burners will maintain steam when gas pressure is too low for other burners to function. Operating on a basic principle of smaller orifices and ports, but more of them, BECK "MELLOBLU" Burners produce shorter flames over a wider grate area resulting in longer boiler life and operating efficiency beyond the rated capacity of the boiler.



No. 18 Melloblu Gas Burner with 108 burner heads and with skids and air shield. Also illustrates new all-steel burner frame construction.

The unitized design of the burners permits make-up to fit any size firebox. Welding is eliminated. This results in more economical installation and the simple and easy removal to new location by merely removing four pieces of steel used as air shields. No firebrick or special refractories are needed. Burners are easy to clean. Low replacement cost on worn or damaged burners. Special skids furnished if desired.

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Traveling Blocks
Tubes, Boiler
Tubing
Turbo Generators
Tongs
Tool Joints
Wire Rope

up, cut into sections and allowed to dry for some time, the problem is much more difficult.

In the course of pressure-testing the pipe with water, each time a split section was cut out for replacement, mud balls of stiff clay or black gumbo were tamped into the two open ends for a distance of from 4 to 6 ft. to plug off the draining line. At least 90 such plugs lay in the line after the test. The line fill of water, together with as much of the mud as would go into suspension, was forced through the line with a 50,000-bbl. batch of No. 2 heating oil. The heating oil cut the dried wax from the pipe wall and thus released other quantities of sand and scale which had accumulated or formed during prior service. This was pushed ahead by a train of scrapers that were inserted and removed at various points en route. Some of these scrapers stuck during the process, and had to be located and cut out of the pipe. Their location was a feat in itself, as it was difficult to find them in the sections coated with Somastic because their movement could not be heard through the coating.

The batch of dirtied heating oil, which was run into the slop system of Standard of Louisiana's refinery at Baton Rouge, was followed with a tender of housebrand gasoline. About 15,000 bbl. of this also was run to slop because it had cut from the pipe wall more wax which made it unfit for motor fuel. The next 120,000 bbl. of gasoline received at Baton Rouge would not pass the "copper strip" corrosion test because of the sulfur compounds picked up from the pipe wall. This quantity, however, tested satisfactory in other respects, so it was set aside in tanks and worked off gradually by blending with subsequent deliveries which had tested negative.

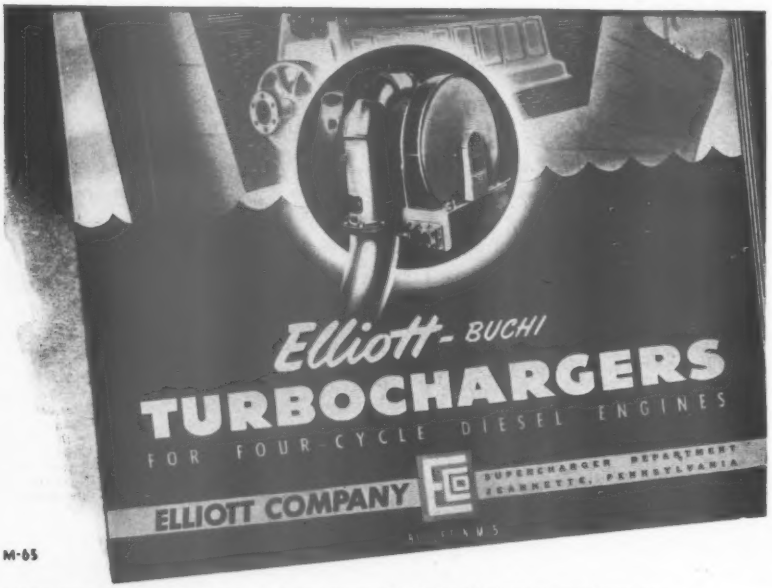
Inasmuch as the various hay tanks were not received on the job until Bayou had operated for several months, the sand and scale which moved with the stream quickly cut through the screen of the twin-basket strainers and continued their abrasive action on the line valves and pumps. Six pumps had their differential pressures lowered 90 lb. per sq. in. by the rapid wear. Extra-heavy steel fittings on throat-bushing drains were sandblasted completely through. Pump-impeller vane and shroud tips were worn to a knife edge. Two bronze pump cases were grooved between stages and had to be dismantled, planed and reinstalled with filler gaskets. External lubrication had to be applied to stuffing-box packings to insure proper performance.

Scrapers and Inhibitor

When the hay tanks were finally installed, maintenance on the equipmen decreased at once to normal expectancy. One by one the rotating elements were replaced by the mechanics, and the line capacity was gradually increased. An intensive program of scraping and cleaning is still in progress, and tons of scale, sand and paraffin are being removed weekly. Scip, the internal corrosion inhibitor process licensed by Shell Development Co., is being injected constantly with the result that the corrosion of pipe and fittings (common in products lines) has been halted. The combined effect of the scraping program and the Scip was to reduce the skin friction of the pipe so much that the maximum daily throughputs of the 10-in. line have increased from about 56,000 bbl. in April to as much as 64,100 bbl. in September. The throughput of the 8-in. line has increased simultaneously from 37,500 to 41,200 bbl. This performance speaks well not only for the designers, who had hoped to achieve maxima of only 60,000 and 37,000 bbl. respectively, but also far the dispatchers who kept four products from six sources scheduled so as to use the full benefit of all available capacity.

With the Bayou and the new northeast extension of the Plantation line in service, motor fuels and burning oils now are moving through a con-

How to get up to 50% *more power* from a four-cycle Diesel engine



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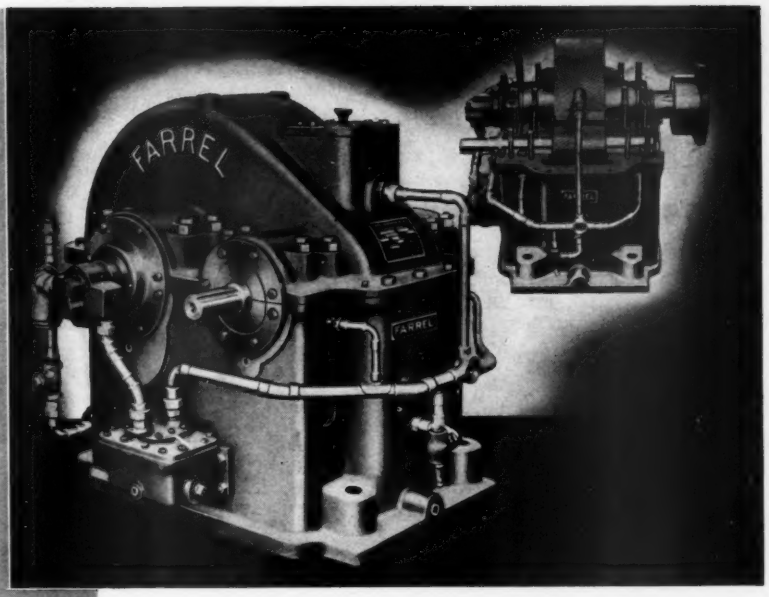
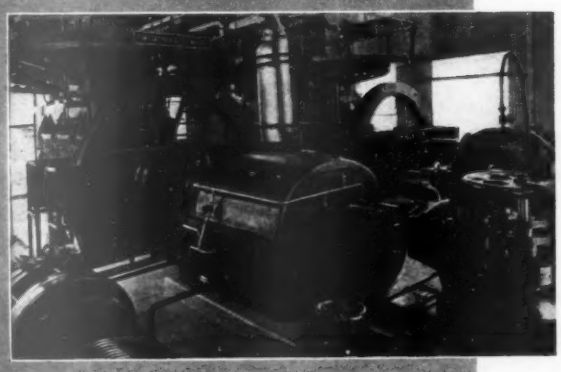
Farrel Type SI Speed Increasing Units are available in a standard series of 47 sizes. Speed ratios of standard units range from 1:1 to 12:1. If higher ratios are required, units using two sets of gears can be supplied with a ratio range from 12:1 to 40:1.



Typical main line pipe line station with single-stage step-up units, 9½:1 ratio, connecting Diesel engines with centrifugal pumps.



Double step-up units, 16:1 ratio, with input and output shafts in straight line, connecting Diesel engines and pumps. Intermediate shaft extensions drive water pump and generator.

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Farrel Type SI Speed Increasing Units are designed for operation at high speeds – service in which the pinion shaft may turn at 6,000 rpm. or faster, or the pitch line velocity of the gears may be as high as 15,000 feet per minute.

Such extremely high speeds present problems in design quite different from those involved in building ordinary industrial gear units. Questions of vibration, impact stresses, noise, lubrication of gears and bearings, can be answered only by specialized engineering skill, manufacturing facilities and experience.

In fact, when we first offered our line of SI units to pipe line companies in 1929 we were greeted with open skepticism. Engineers said a satisfactory transmission could not be made. But today scores of these units are in use – performing as we said they would fourteen years ago. The many repeat orders tell the true story.

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tinuous system from as far as Texas City, Texas, to Richmond, Va., a total of 1,262 miles. Thus, through this combined line, Texas products are being delivered to the ultimate consumer in the East who will be enabled to drive his automobile a few more miles each week and to keep his home a few degrees warmer next winter. Although the Bayou Pipe Line System was conceived as a war emergency project, and every possible barrel now is being crowded through it, it should serve a continued usefulness after the war—though perhaps at a reduced throughput.

Under the direction of C. D. Winkelman, system superintendent, the men in key Bayou jobs in the Houston office are: L. J. Rittiner, system engineer; G. H. Miller, chief dispatcher; W. H. Astley, chief accountant; and J. A. S. Fraser, master mechanic. The key men in Bayou's field organization are: S. B. Bean, superintendent Texas division; W. H. Craddock, superintendent Louisiana division; J. R. Luttrell, chief chemist; C. P. Wilson, supervisor Baytown terminal; W. H. Smith, supervisor Neches terminal; and C. V. Walden, chief gager Baton Rouge terminal. All of the Shell Pipe Line senior personnel previously mentioned, together with their staffs, are available to deal with Bayou's special problems.

Twenty-two Tankers Delivered in August

WASHINGTON, D. C. — Sixteen ocean-going tankers and six coastal tankers were included in the total of 164 cargo vessels delivered by the nation's shipyards in August, it was reported here last week by the Maritime Commission.

Fifteen of the tankers were delivered to the Maritime Commission and one to a private owner.

Sun Shipbuilding & Dry Dock Co., Chester, Pa., continued to set the pace in tanker construction, delivering six vessels during the past month. Kaiser Co., Inc., Swan Island, Portland, Ore., delivered four.

August deliveries increased the number of tankers delivered so far this year to 96 ocean-going vessels and 14 of the coastal type.

There were 62 tankers delivered in all of 1942.

The tanker program is being further enlarged by the conversion of 102 liberty ships into oil carriers. These vessels, after certain alterations, will serve as tankers with a capacity of 65,000 bbl. of petroleum products each.

Production schedules call for the delivery of 489 additional tankers of all types in the next 16 months, "so that by the end of 1944 a total of 661 tankers will have been delivered since Pearl Harbor."

Positive-Displacement Variable-Capacity Pumps in Butane Pipe-Line Service

by E. A. Koenig*

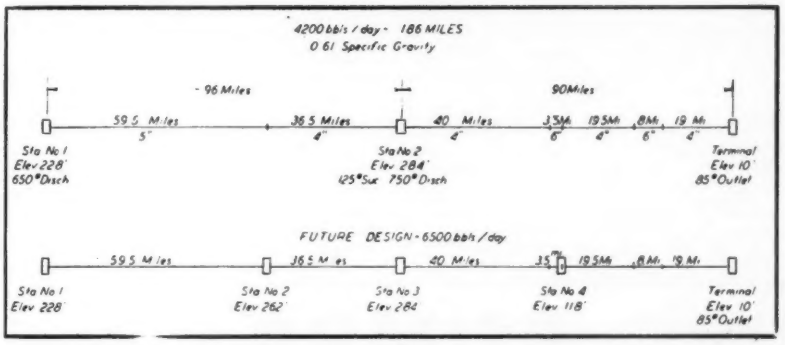
A REVIEW of the history of our butane pipe line will show the reason for certain engineering problems encountered and why the pipe line and stations were designed as they were. This line was built in 1939 and began operating in December of that year.

The problem resolved into a pipe line and stations having a capacity of 4,200 bbl. per day, a pipe-line distance of 186 miles, pumping a mixture of propane, butane and casinghead gasoline having a specific gravity of 0.61. The design was to include the future possibility of moving 6,000 to 7,000 bbl. per day.

The pipe sizes were selected in the following manner. The initial station has an elevation of 228 ft. and pumps through 59.5 miles of 5-in. line, 36.5 miles of 4-in., or a total pipe-line distance of 96 miles. The initial station operates at 650 lb. per sq. in. discharge and the intermediate station operates at 125 lb. per sq. in. suction pressure. The intermediate station has an elevation of 284 ft. The discharge pressure of this station is 750 lb. per sq. in. pumping through 40 miles of 4-in., 3½ miles of 6-in., 19½ miles of 4-in., 8 miles of 6-in. and 19 miles of 4-in. into the terminal station. The second section has a total pipe-line distance of 90 miles with an outlet pressure of 85 lb. at an elevation of 10 ft. A diagramatic sketch of the pipe line for 4,200 bbl. as well as a 6,500-bbl. future design is shown to explain arrangement of pipe and stations.

Right-of-way and station sites were already available; therefore, the old right-of-way was used. Pipe diameters in the butane line were varied in order to have a more favorable hydraulic balance between stations. The butane pipe line and stations are relatively small and through the installation of automatic stations it has been possible for the existing crude-oil station operating personnel to operate the butane stations in conjunction with their crude-oil-station duties.

*Superintendent, Butane-Gasoline Pipe Lines, Magnolia Pipe Line Co.



Diagrams of Magnolia butane line, one of which shows amount of pipe of different sizes and location of stations of the present system for moving 4,200 bbl. daily while the other shows location of additional stations when future needs may require moving 6,500 bbl. daily

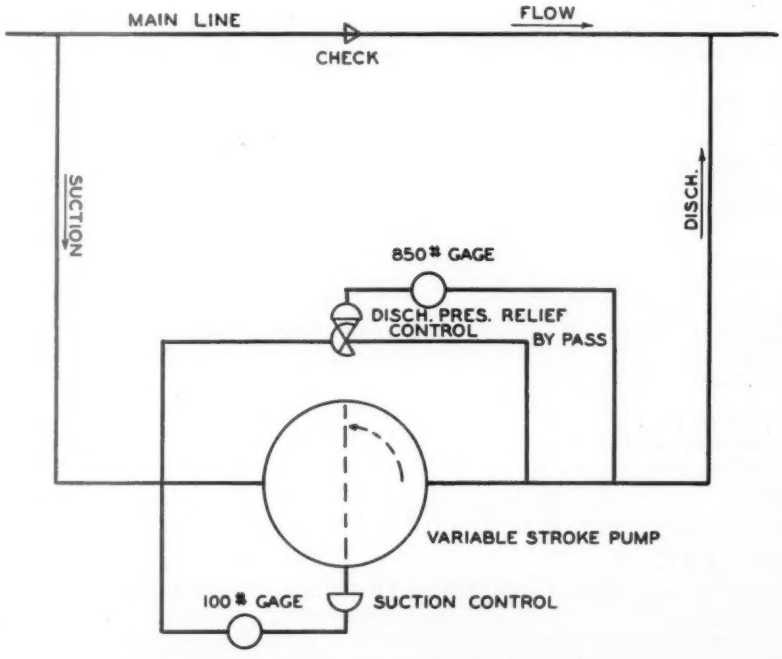
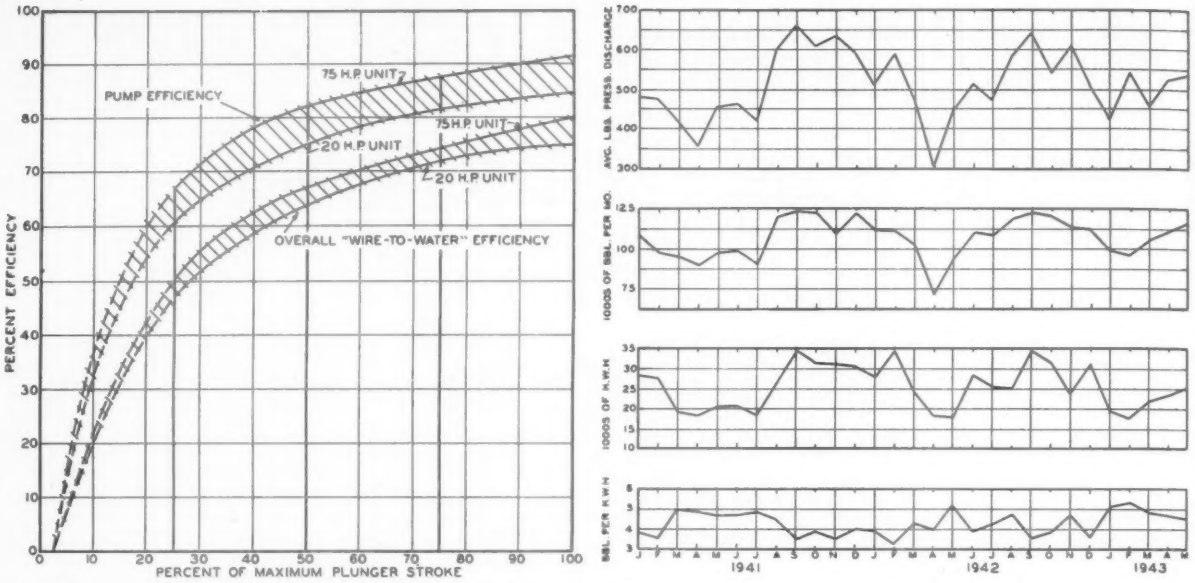


Diagram of piping of pump station on butane line

To avoid operating difficulties through the failure of mechanical equipment or neglect of proper attention, the entire pipe-line system including suction and discharge of stations was designed for a working pressure of 1,200 lb. per sq. in. The initial station (1) was to have two 10,000-bbl. spherical storage tanks for 125 lb. per sq. in. All intermediate stations boost the pressure and pipe-line capacity without additional storage or working tanks. This method was adopted to conserve steel, lower initial cost, and decrease evaporation losses. The problem became complex in regard to the selection of equipment because of the high discharge heads, low specific gravity of the fluid to be pumped, and low operating efficiencies to be encountered as previously explained.

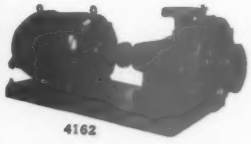
Centrifugal pumps running 3,700 to 3,900 r.p.m. with only 66 per cent effi-



Left—Typical performance characteristics of constant speed, variable-stroke motor-driven triplex pumps, from tests on 20 and 75-hp. units. Right—Charts showing data from operation of butane line for nearly 2½ years, including discharge pressure; throughput; electric power consumption, and barrels per kilowatt hour

ciency require 124 brake horsepower at the shaft. This would call for engines and step-up gears, or electric motors and step-up gears, or, frequency changers. This also meant prime movers of 180 to 200 hp. Packing problems were not so simple for past experience had taught much in the handling of propane and butane in the operation of gasoline plants. Threaded ¼-in. fittings using hydraulic 2,000 lb. per sq. in. forged steel fittings and bar stock valves would hold propane and butane up to 600 lb. per sq. in. At 850 lb. pressure, fittings would fail within 3 to 90 days at the threaded connections. Various thread compounds were used

PUMPS
CENTRIFUGAL
RECIPROCATING


4162

4113C

4135H

The National synthetic rubber production is expected to reach over 240,000 tons at the end of 1943.

Our pumps are on the job in several plants helping make this production possible.

Cuts are photographs of a few of the different pumps of which we have many duplicates that are operating at this time in synthetic rubber plants.

We are proud to be participating in something so vital to our war effort.

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DEAN BROTHERS PUMPS INC.

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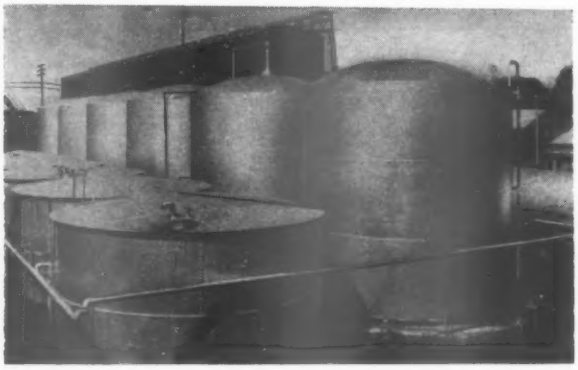
INGALLS 100%-WELDED TANKS



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before these pressures could be held on gage lines and instrument-control equipment. It must be remembered that these nipples and thread fittings do not rotate at speeds at 3,800 r.p.m., neither are they supposed to reciprocate.

Reciprocating plunger-type pumps appeared to be the most desirable from the standpoint of mechanical efficiency, as well as for the control of the stuffing boxes and for making adjustments during operation. The normal types of reciprocating pumps were not as flexible as desired. Mechanical efficiency of 85 per cent or higher with a volumetric efficiency of 90 per cent or more were good. Mechanical speed-changing devices installed between the pumps and prime movers gave a variable capacity of 52½ per cent. Engine-driven reciprocating pumps with an overriding governor control permitted 60 per cent speed variation of the engine and resulting increased pump capacity.

Because of the high efficiency of variable-stroke pumps and the possibility of automatic control governed by the operation of the initial station, we chose the 0-6-in. variable-capacity pipe-line pumps for the solution to our problem. Furthermore, by employing them the fractionating column could be charged 186 miles away, by rate of flow control, without the use of storage tanks at the terminal end of the line. A typical performance characteristic curve is presented to show the efficiency in relation to the per cent of maximum stroke. The curve is taken from a 2⅝-in. diameter by 0 to 6-in. stroke, 200 r.p.m., 75-hp. unit similar to the units we purchased. These curves are based on water, 1,450 lb. per sq. in. discharge and 18.5 lb. per sq. in. suction pressure. Pumps were purchased with 3¼-in. diameter porcelain plungers equipped with deep stuffing boxes and equipped with lubricators for castor-oil lubrication to the lantern rings of the packing glands. A diagram of the automatic control is shown to explain how the suction pressure at the intermediate station is controlled, by varying the stroke capacity of the pump. In case of excess pressure an overriding separate discharge-pressure control opens a bypass valve releasing the excess discharge pressure back to the suction of the pump. If the discharge pressure becomes too high and the bypass control opens, raising the suction pressure, the pump will of course proceed to full stroke capacity. The suction pressure will continue to rise beyond the instrument-set pressure. This will cause an increase of pressure to be reflected back against the initial-station discharge pressure, causing the initial station to reduce its stroke capacity and the desired discharge pressure is maintained at its predetermined setting.

A suction pump was installed to permit pumping out of low tanks, also to aid in starting the station when the pipe-line connections and pump are at a higher temperature than the fluid in storage. At times when the fluid in the tanks is at 70 lb. per sq. in. and has a temperature of 85° F., the connecting lines to the main-line pump will be at temperatures of 115° F. or 120° F. Under this condition the fluid in the suction to the main-line pump would vaporize and would tend to vapor-lock any pump.

Control Instruments

All instruments controlling station pressures operate by air at 15 lb. per sq. in. and failure of air supply opens the discharge pressure bypass valve and returns the pump to zero stroke or capacity. In the event that the intermediate station is lost through power failure or instrument control failure the check valve on the main line opens and permits the stream to bypass the station. Since the suction and the discharge of the station is designed to stand 1,200 lb. per sq. in. no serious effect from such a condition will result. All station head gates affecting the suction and discharge of the station and stopping of machinery can be operated by remote control at some distance from the station.

The first two pumps placed at the

• • • WHEN
HILL-HUBBELL
STEEL PIPE PROTECTION WILL BE IN GREATER DEMAND

When that time comes, our then realized plans will meet that demand with improved techniques.

Meantime, those whose underground steel pipe is being conserved with HILL-HUBBELL work have the security that goes with sound investment.

HILL-HUBBELL Steel Pipe Protection is applied at these leading mills:

- **Jones & Laughlin Steel Corporation**
- **National Tube Company**
- **Spang Chalfant, Inc.**

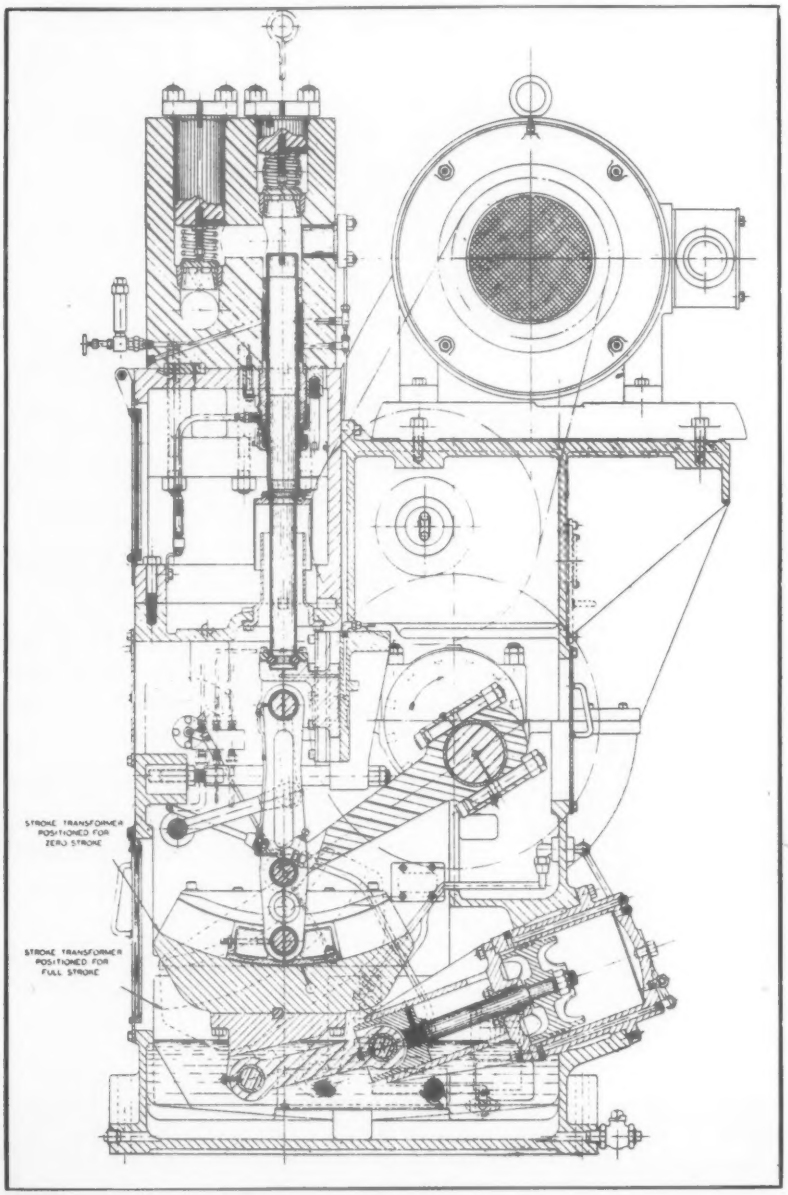
GENERAL PAINT CORPORATION
HILL, HUBBELL & CO. • Division • Cleveland, Ohio
• EXPORT OFFICE: SAN FRANCISCO, CALIFORNIA, U. S. A. •

initial and intermediate station sites were placed in operation in April 1940 and ran continuously without standby until the latter part of 1942. In December 1942 standby equipment was installed as the line is to maintain as nearly 100 per cent capacity as possible. The first two variable-stroke pumps have all of the original parts as shipped from the factory with these exceptions. Valves and seats were ground with fine valve-grinding compound at three different times although the capacity of the pump had not changed enough to be detected; 0.006 shims were removed from connecting rod bearings on both pumps. Porcelain plungers developed a slight leak between the porcelain and the top steel cap and gasket. These were returned to the manufacturer for reconditioning, and were broken by the railroad company in transit. The new porcelain plungers received now seem to be satisfactory. Packing life was 15 months when the porcelain plungers were removed at our initial station. Porcelain plunger wear was negligible as compared to original factory measurements. The failure of one coupling drive, driving the lubricating-oil pump, gives the sum total of repair parts and replacements to date. The pumps were bought for 4,300 bbl. per day capacity; the following data from recent pumping for a typical 12-day period indicates the consistent performance to be expected from these pumps:

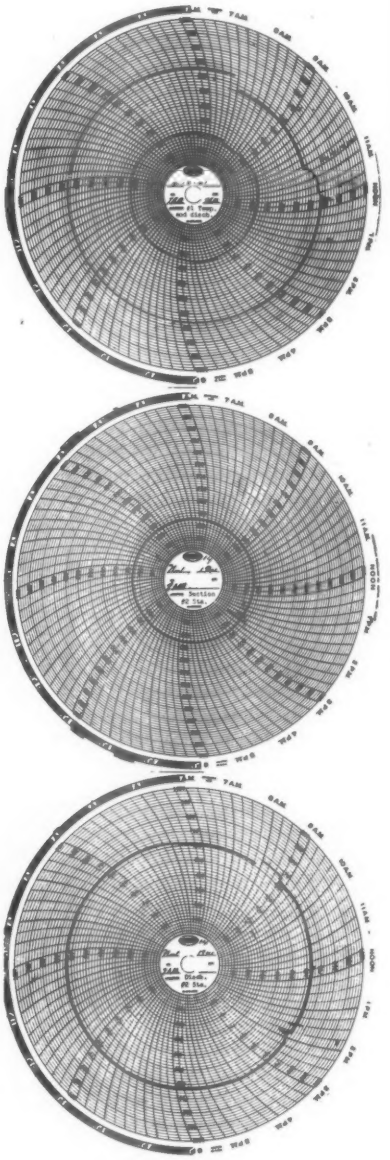
Pumped—4,310, 4,238, 4,306, 4,324, 4,310, 4,331, 4,305, 4,302, 4,301, 4,348, 4,306, 4,303; average 4,307.

Pump valves have not been touched in the last 26 months. Until delivery of variable-stroke pumps could be made, the line was operated with conventional piston-type pumps. These piston-type pumps gave considerable trouble and required overhauling of the fluid ends at intervals of from 3 to 90 days. The cost of parts was considerable. It must be remembered that these pumps were not designed for butane service.

In the operation of the butane system with variable-stroke pumps, charts of the initial (1) and the intermediate station (2) are shown so that the reader may see the result from

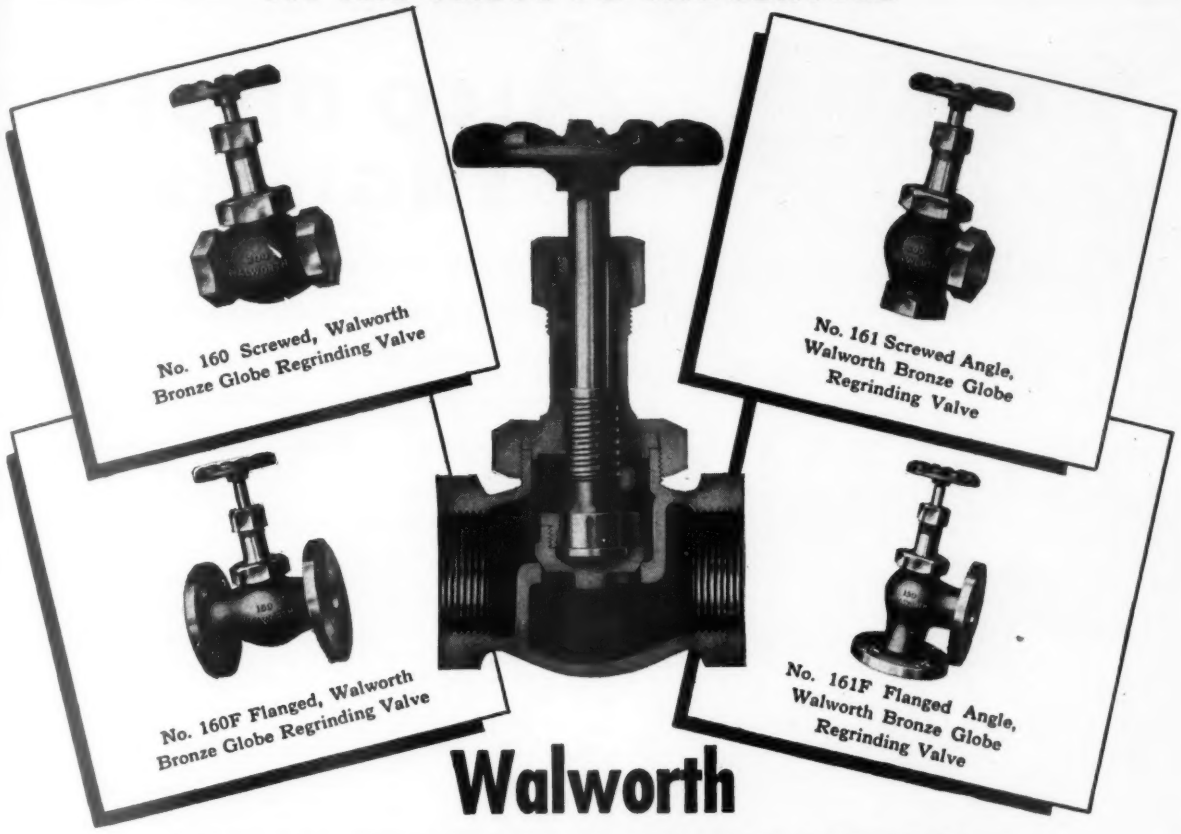


Transverse section of variable-stroke pump



Typical charts showing: (top) temperature and discharge pressure at No. 1 station; (center) suction pressure at No. 2 station; (bottom) discharge pressure at No. 2 station

FIT THE VALVE TO THE SERVICE


No. 160 Screwed, Walworth Bronze Globe Regrinding Valve
No. 161 Screwed Angle, Walworth Bronze Globe Regrinding Valve
No. 160F Flanged, Walworth Bronze Globe Regrinding Valve
No. 161F Flanged Angle, Walworth Bronze Globe Regrinding Valve

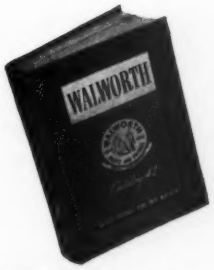
Walworth
BRONZE REGRINDING VALVES

• • •

choose the type that fits your service

When you need a Bronze Valve select from Walworth's *complete line* the one that precisely fits your service. Take this line of regrinding valves, for example. These valves are made both in Globe and Angle types with either screwed or flanged ends. Union Bonnets give added strength. All valves have bronze discs and full-way seats. Moreover, well proportioned stuffing boxes and glands assure leak-proof operation. These valves can be repacked under pressure when fully opened, and should the seats and discs become worn, they can be reground.

Each Walworth Valve has distinctive features of design and construction. You can save time, material, and much troublesome maintenance when you "fit the valve to the service."



To help you "fit the valve to the service," you'll find pertinent information on Walworth's complete line of valves, fittings, pipe, and pipe wrenches in the New Walworth Catalog 42. Included are 78 pages of practical engineering data that simplify valve selection and make piping layouts easier. Write, on business stationery, for your free copy. Address: Walworth Company, 60 E. 42nd St., New York 17, N. Y., Department 913.

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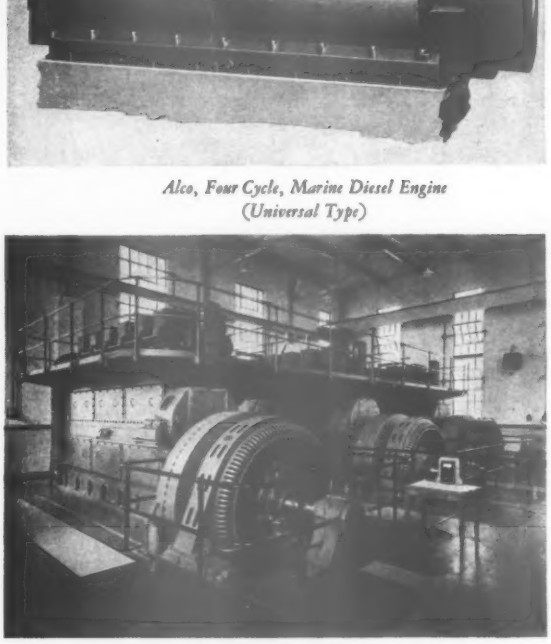
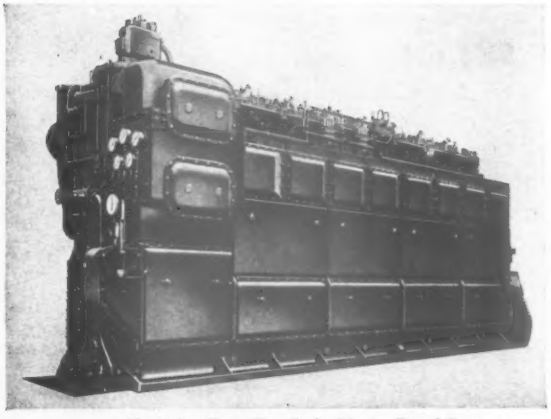


Alco, Four Cycle, Stationary Diesel Engine



Alco-Sulzer Type, Two Cycle, Marine Dtesel Engine

ALCO DIESEL ENGINES

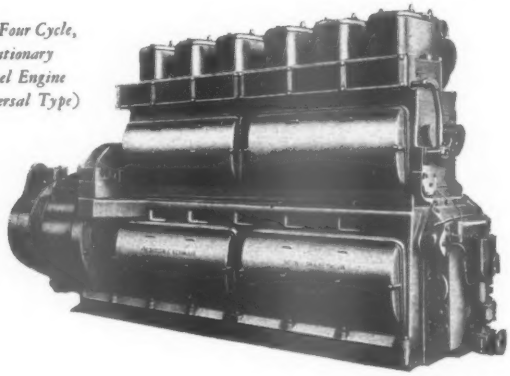
Alco builds high and low speed Diesel engines of 2 and 4 cycle principle for Railway, Stationary and Marine service. Alco is therefore in a position to offer an engine that best suits any application within its field.

ALCO DIESELS

Model	Cycle	H.P.	R.P.M.	Application
6—12½ x 13	4	660	700	RAILROAD
6—12½ x 13-T*	4	1000	740	RAILROAD
6—12½ x 13	4	540	600	STATIONARY
8—12½ x 13	4	720	600	STATIONARY
6—12½ x 13-T*	4	810	600	STATIONARY
5—17½ x 25	4	730	257	STATIONARY
6—17½ x 25	4	875	257	STATIONARY
8—17½ x 25	4	1170	257	STATIONARY
4T—14 x 23½	2	720	277	STATIONARY
5T—14 x 23½	2	900	277	STATIONARY
6T—14 x 23½	2	1080	277	STATIONARY
8T—14 x 23½	2	1440	277	STATIONARY
M6—12½ x 13	4	540	600	MARINE
M8—12½ x 13	4	720	600	MARINE
M6—12½ x 13-T*	4	810	600	MARINE
4TM—14 x 23½	2	720	277	MARINE
5TM—14 x 23½	2	900	277	MARINE
6TM—14 x 23½	2	1080	277	MARINE
8TM—14 x 23½	2	1440	277	MARINE

*Exhaust turbo pressure charged by the Buchi System.

Alco, Four Cycle, Stationary Diesel Engine (Universal Type)



AMERICAN LOCOMOTIVE COMPANY
DIESEL ENGINE DIVISION
AUBURN • NEW YORK

tank changes at the No. 1 station and the effect of a shut down at the No. 1 station, on the No. 2 station. Also the effect of pressure changes as initiated at the No. 1 station. Other variations in the station charts were brought about by curious visitors wanting the operator to show how the equipment changes stroke. A data sheet shows the pump data of 0-6-in. by 3¼ reciprocating triplex pump at 200 r.p.m. or 600 s.p.m. driven by a 75-hp. induction motor. The data began in January of 1941 through May 1943 and is graphic. To sum up the highlights of the butane pipe-line system discussed in brief, the principal features are as follows:

Closed system—no working tanks on main line at intermediate station; reciprocating triplex pump at 200 r.p.m., 600 s.p.m.; intermediate station taking suction at 125 lb. and discharging back into the line at 850 lb.; no tanks; first station pumps 96 miles, second station pumps 90 miles into fractionator charging the column; no tanks; rate of flow control 186 miles away from the fractionating column being charged.

Auxiliary equipment connected through power meter consist of one 75-hp. main-line pump; one 10-hp. suction pump; one ¾-hp. air compressor; one ½-hp. air compressor; one 2,600-watt spare heater; one 2,100-watt spare heater; one 2,500-watt water heater, and 2,850-watt lighting.

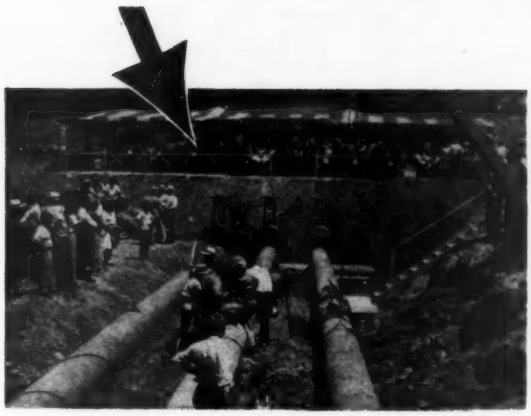
Significance of the New WEP Pipe Lines

Many within the industry as well as those living along the routes of the WEP 24-in. crude and 20-in. products lines still do not grasp what these systems will accomplish. If instead of a pipe line, the project consisted of a canal which would float ocean tankers (not river barges) it would be easier to visualize the significance of facilities which will be moving 300,000 bbl. of crude and 235,000 bbl. of products daily.

Coke Pool Outlet Is Completed

A 30-mile 6-in. line recently has been completed from the Coke pool, Wood County, Texas, to the refinery of Talco Asphalt & Refining Co., Talco, Tex.

The asphalt base crude of the Coke pool is reported to contain 17 per cent less asphalt than the crude from the Talco and Sulphur Bluff pools in that area. In the immediate future the refinery will be running about 2,100 bbl. daily of Coke crude in addition to Talco and Sulphur Bluff crudes.



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With the opening of M & H Valves in the famous "Big-Inch" pipe line, the oil and gasoline shortage in the East is relieved and America's war effort strengthened. A great many M & H Valves are installed at points along this 1400-mile pipe line from Texas. The World's largest pipe line requires dependable, rugged valves like M & H to control its delivery of 300,000 bbl. of oil daily to Eastern refineries.

M & H Valves are iron body, bronze mounted with double-disc parallel seat or soild wedge type, non-rising stem or outside screw yoke. They are made either with flanged or screwed connections. M & H products have been widely used for many years and are well known for high quality and expert workmanship.

Photograph reproduced above was made at dedication ceremony for "Big-Inch" at Phoenixville, Pennsylvania—showing M & H Valves installed at that point.

M & H VALVE AND FITTINGS COMPANY

ANNISTON, ALABAMA

A High-Pressure Natural Gas Gathering System

by E. J. McConnell *

THE trend of operating pressures of natural-gas transmission lines has been upward during the past few years, one reason for which probably has been the improvement in dehydration processes or the removal of the water from the gas, thus eliminating the interruption of flow resulting from the formation of hydrates at the higher pressures. A number of pipe lines have been constructed recently for operation at pressures of 1,000 lb. per sq. in. and above, all of which require dehydration.

Although dehydration eliminates hydrate troubles on high-pressure main-line operation, the problem of high-pressure gathering still remains. For insured continuous operation of a gathering system at high pressure one of three conditions must prevail: The gas must contain no liquid water; its temperature must be above the hydrate formation point corresponding to the operating pressure; or the freezing point of the water must be lowered by the addition of alcohol, ammonia, or other such substance. Inasmuch as gas is generally saturated with water when produced from wells, the first solution cannot be met except by the installation of dehydration plants on all wells connected to the gathering system, an arrangement generally prohibitive because of high initial and operating costs. Maintaining the temperature of the gas above the hydrate formation point is probably the most practical for general use. The use of antifreezes, although essentially satisfactory, is somewhat costly and troublesome for continued operation.

Oklahoma Natural Gas Co. was confronted with the problem of gathering high-pressure gas in connection

*Chief engineer, Oklahoma Natural Gas Co.

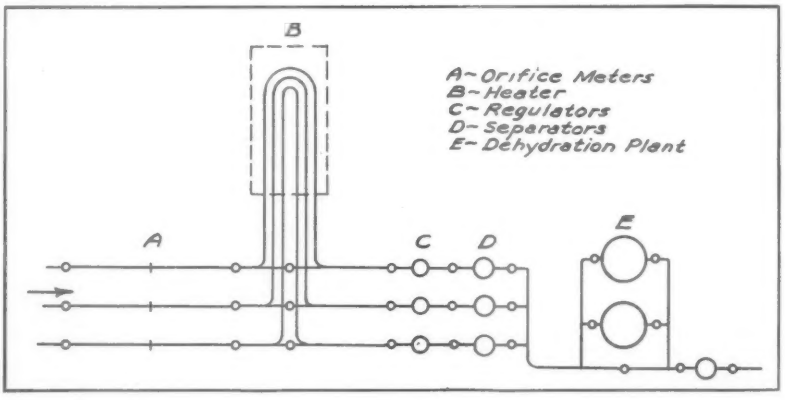


Fig. 2—Control-station layout

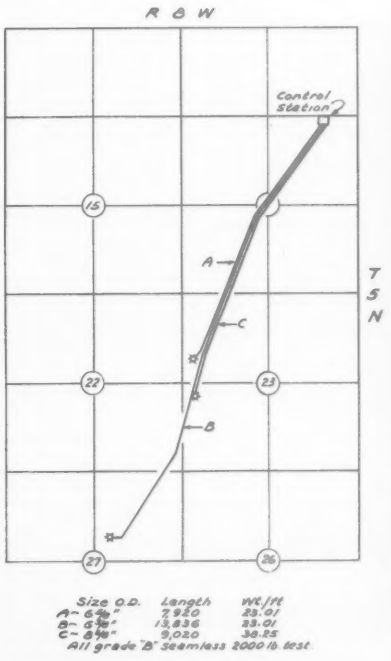
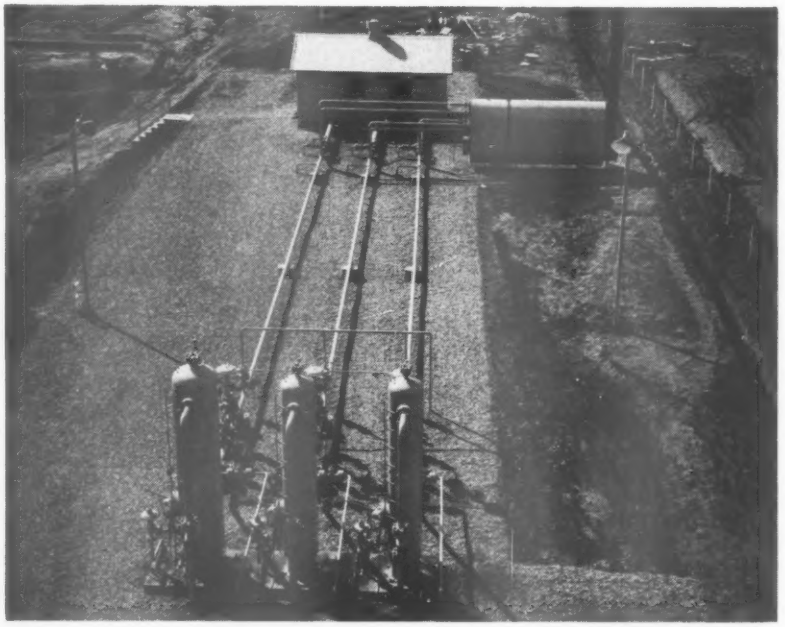


Fig. 1—Map of Chickasha gathering system



Separators, regulators, heater and meter house at the control station

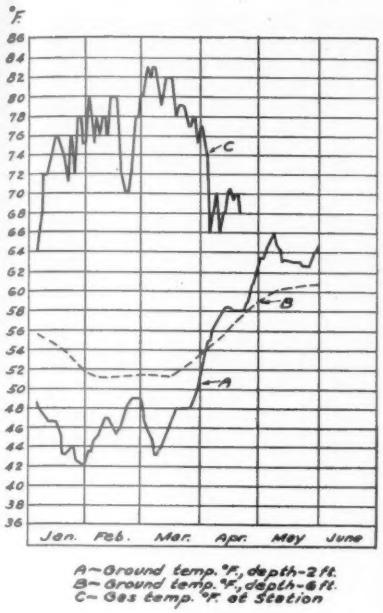
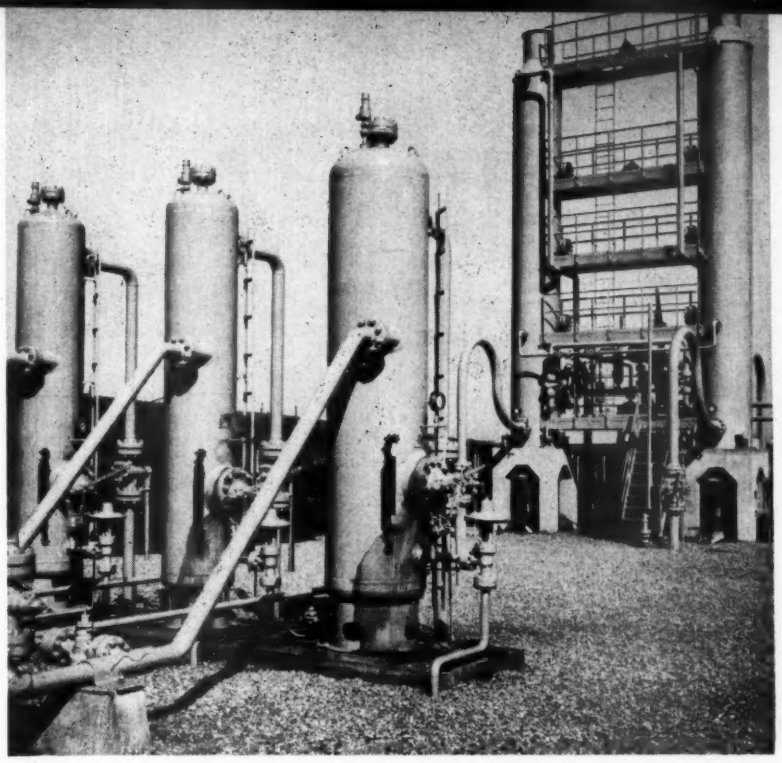


Fig. 3—Curves showing soil temperatures and downstream gas temperature on longest line in the gathering system.



Separators and dehydration plant at control station

with the construction of a pipe line from the Chickasha gas field to operate at a maximum pressure of 1,000 lb. per sq. in. The line was to have a capacity of 70,000,000 cu. ft. per day at the top pressure and three wells were to be connected into the line. It was decided to bring the gathering system together to a central point at the company's field warehouse and compressor station site near the north end of the field, and to operate each well from that point. The lines to the wells thus carrying full well-head flowing pressure of about 1,600 lb. per sq. in. from the well to the control point. The elimination of controls at the wells was primarily to aid in operation because the roads in the field were virtually impassable at times during the winter. It was hoped to bring the gas to the central point at a temperature high enough to prevent hydrate formation.

The gas temperature at the well head was measured to be 83° F. at 1,600 lb. per sq. in. flowing pressure. The hydrate formation point was known to be about 72° F., allowing only a temperature drop of 11° F. through the gathering lines. Data for design of the lines were obtained from the U.S.M.B. Report of Investigations, "Temperatures of Natural-Gas Pipe Lines and Seasonal Variations of Underground Temperature." From this report and other similar data, it was estimated that an over-all heat transfer coefficient of about 0.28 B.t.u. per sq. ft. per degree temperature difference per hour could be expected between the gas and the ground. By laying the lines at an average depth of 5 ft., it was estimated that a minimum soil temperature of 48° F. could be anticipated. The diameters of the lines were chosen so that the maximum pressure drop through each line would not exceed 50 lb. per sq. in. Minimizing the pressure drop was felt to be of particular importance because of the resulting temperature drop caused by throttling effect of the line. The required temperature of the gas entering the gathering line was thus calculated for different flow conditions and it was found that some

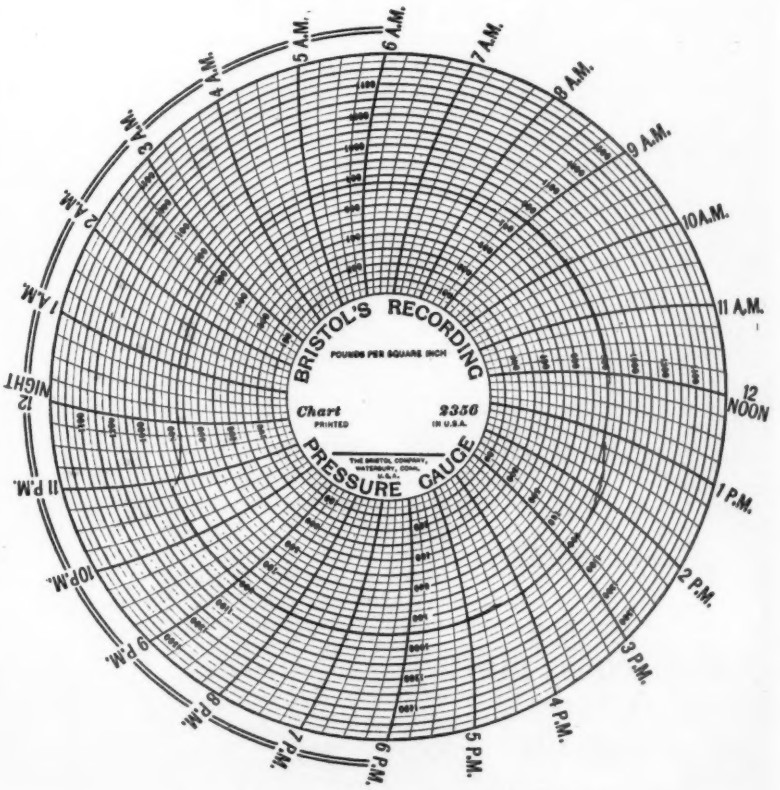


Fig. 4—Transmission-line pressure, 24-hour period

heat would have to be added to the gas. This was done by using automatic water-bath heaters, each heater containing a 3-in. flow-tube bundle. Calculations indicated that the minimum temperature required at the well head would be at the design maximum flow condition, and that an increased temperature would be required at higher rates of flow to offset the temperature drop due to throttling and at lower rates of flow to offset the temperature drop due to heat loss to the ground.

The central metering and regulating stations and dehydration plant was designed to centralize all operations. Orifice-meter settings for each well were located on the inlet side of the station. A heater was designed to heat the gas leaving the meter runs in preparation for reducing the pressure to 1,000 lb. per sq. in., the pressure carried on the separators and dehydration plant. This heater consisted of three 3-in. flow-tube bundles in a common water bath, the temperature of which was thermostatically controlled. The heater was designed for a maximum gas temperature rise of 90° F. to compensate for an equal temperature drop through the regulators.

Construction of the system was essentially as designed. The three well lines were laid as closely together as possible to take advantage of the mutual heating effect of the lines on the soil, the distance between centers of the lines being about 5 ft., as closely as they could be constructed without unusual difficulties.

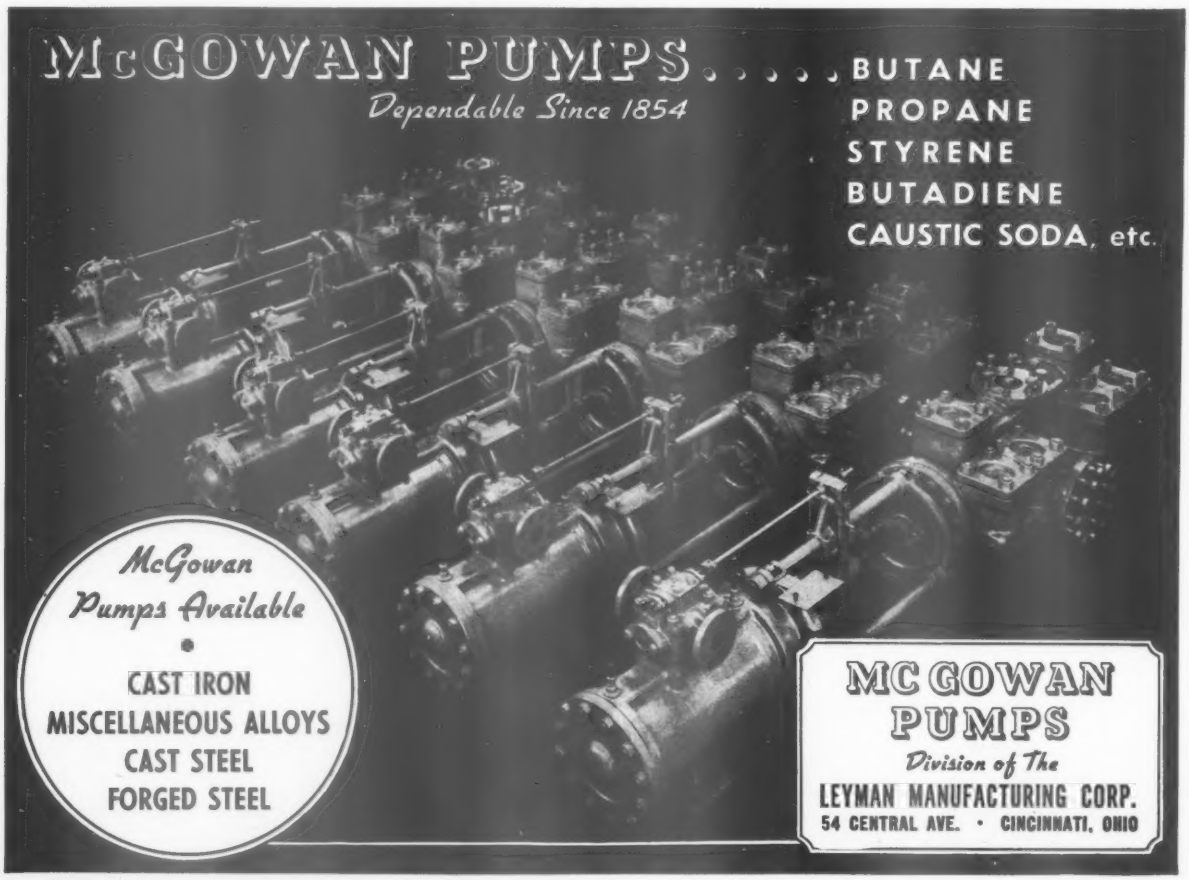
Separators were installed at the control station to remove liquid water and condensate from the gas before dehydration. The dehydration plant is of the dry adsorbent type, using Florite desiccant as the drying agent.

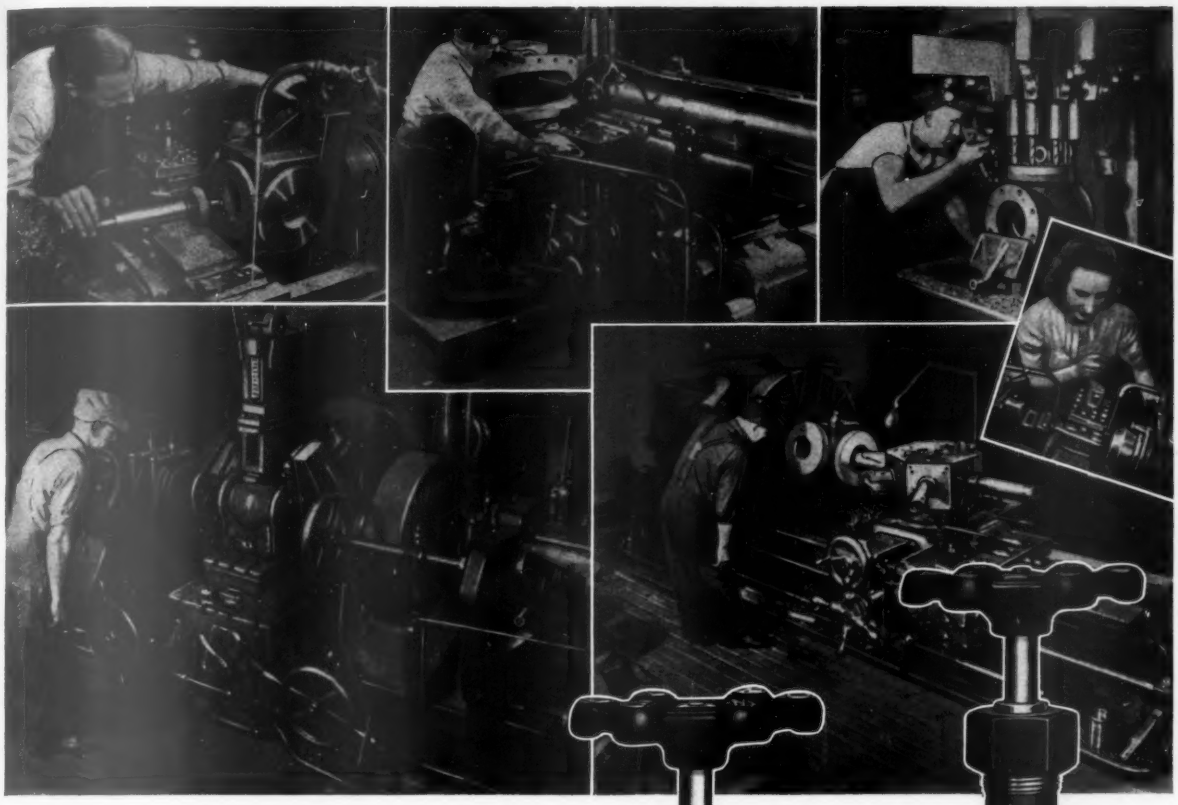
The two main towers of the dehydration plant were made of two used Cross cracking reaction chambers because new pressure vessels of sufficient size and weight were not available at the time of construction. The only departure from conventional design was to insulate the inside walls of these towers in addition to the usual outside insulation. The inside insulation, which is steel covered rock wool, was installed to prevent excessive heat transfer by the extra thick 4-in. walls of the vessels. The performance indicated that heat transfer had been reduced probably below that of towers of normal wall thickness. The time necessary to heat the drying beds during the regeneration process compares favorably with accurately designed towers having no excess wall thickness.

Satisfactory operation of the system through one winter has now been obtained. At no time did any hydrate troubles develop and the temperatures of the gas entering the control station were generally slightly above those calculated in connection with the design. Fig. 3 presents the results obtained on the longest well line, its length being about 2.5 miles. At one time in the latter part of February, the heater at the well was out of order which resulted in the depression in temperature shown. Operation of the heater was discontinued in April. This particular well line crossed a swampy section of ground for about ¼ mile which has little effect on the temperature of the gas except for the warming-up period after the well had been shut in for several days.

The control station is operated by one man on each shift. His duties are to increase or decrease delivery into the transmission line upon orders of the pressure dispatcher and to switch drying towers of the dehydration plant every 8 hours.

Fig. 4 shows that the inlet pressure of the transmission line is easily and highly accurately controlled by a regulator. The accuracy of control permits the transmission line to be operated safely at the highest allowable pressure during periods of peak demand. The orders of the pressure dispatcher can also be put into effect without the usual delay.





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With the skill born of long experience, **POWELL** craftsmen "finish" the product that will honor the family motto—"Standard for Control." These valves started their career from the point of an engineer's pencil—part of the process of POWELL's creative cooperation with technical and maintenance staffs. In every process of manufacture these valves have been tested to POWELL's pre-determined requirements for material, function, longevity . . . to the letter of the law of POWELL's specialized manufacture of valves and nothing but valves.

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Cincinnati, Ohio

Fig. 1992–A 250-pound screwed-end Gate Valve with malleable iron body, screw-in bonnet and packing nut. Has integral seats, hard bronze taper wedge double disc and cadmium-plated carbon steel stem. Made in sizes ¼" to 2", inclusive. Also available with stainless steel stem (Fig. 1993).

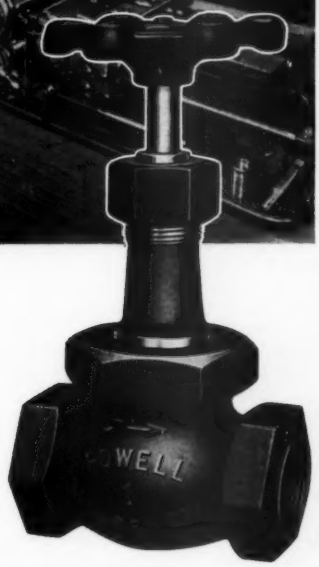


Fig. 1988–A 250-pound screwed-end Globe Valve with malleable iron body, union bonnet, bonnet ring and packing nut. Has cadmium-plated carbon steel stem, stainless steel seat and hard bronze semi-cone, plug type disc. Made in sizes ¼" to 2", inclusive. Also available with stainless steel stem (Fig. 1990).

POWELL VALVES

Portable Precast Concrete Stairway of Unusual Design Protects Fire Wall

by Harry Nelson *

SCARCITY of materials prompted Empire Pipeline Co. to develop the precast concrete stairway shown in the accompanying photograph. It is fabricated from concrete, junk, sucker rods and junk steel plate. The primary features are long life, portability, flexibility and safety.

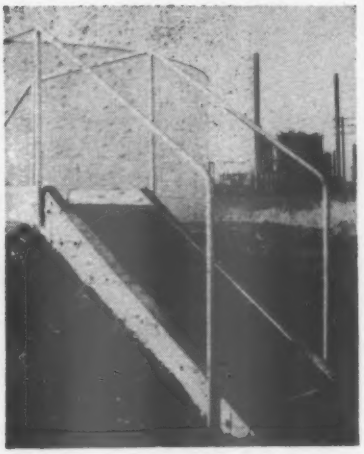
Psychology played a major role in the design of this stairway. Employes will not use a stairway that causes them to climb to an elevation higher than the firewall. They will invariably scale the embankment instead. It is just human nature to choose the shortest route regardless of the hazards involved. A well-worn path at one side of the usual stairway is mute evidence of this quirk. Consequently, this new stairway is built so that it can be recessed into the top of the firewall (not recessed in photograph) without danger of deterioration or rot. Furthermore, the easy 1½ to 1 slope and wide rough treads make it much easier to climb than any pathway.

The treads and stringers are cast separately at a certain point and easily assembled on location. Junk pipe or heavy sucker rods can be used for the hand rails, and are welded to the joint plates. The whole assembly hangs from the top of the firewall, and flexible joints prevent damage from earth settlement. Hauling the parts is no problem because the entire stairway for a 6-ft. firewall weighs only 1 ton.

Each tread has two ⅝-in. sucker rods which protrude into corresponding holes in the stringer. The last tread in each section has threaded rods which extend through the stringer to receive the steel joint plates and nuts. The joint plates are slotted to provide for angular deflection without damage. The walkway across the top is a series of tread slabs, cast in the same mold, but without the protruding rods.

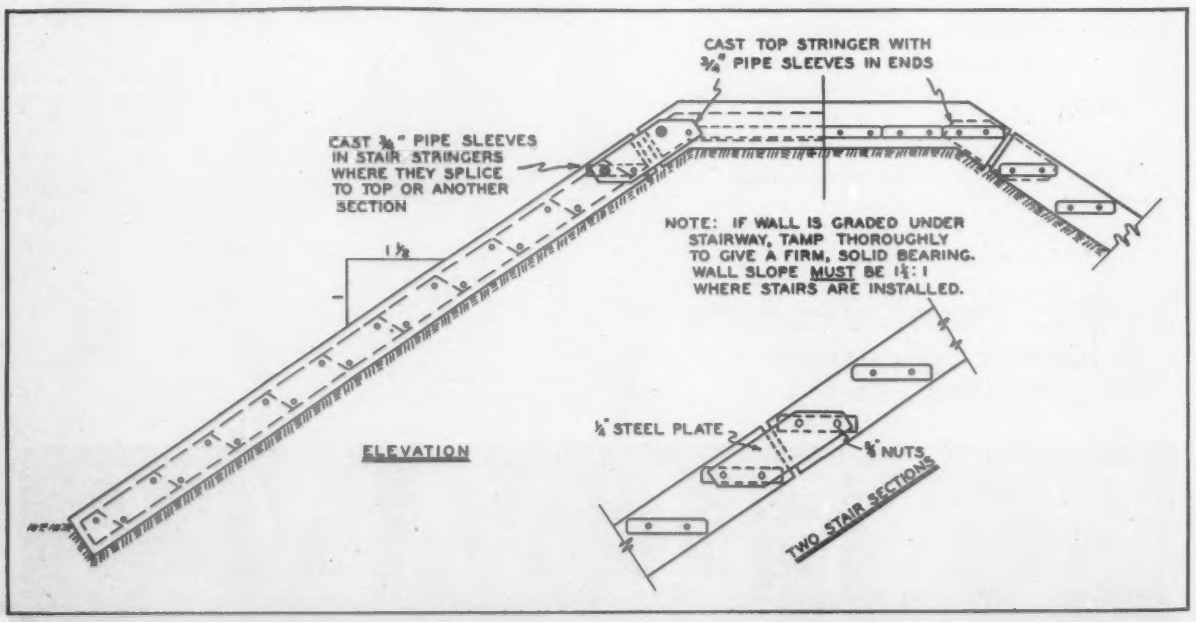
The molds are fabricated from used tank steel and can be used indefinitely.

Several molds are desirable for casting the treads, but only one mold is required for the walkway stringers, and one mold for the stair stringer. The mold for the stair stringer is 10 ft. long and any length stringer up to 10 ft. may be cast in it. Longer stair stringers are made up in sections joined together with the above-mentioned joint plates. Steel plugs having a slight taper form the holes in the stringer for the tread rods. The plugs are attached to the forms by means of a nut on the under side, which permits removal of the concrete, while relatively green, without damage.



The maintenance of fire walls at tank farms in condition required for service is facilitated by use of special stairways

*General superintendent, Empire Pipeline Co.


CAST TOP STRINGER WITH ¾" PIPE SLEEVES IN ENDS
CAST ¾" PIPE SLEEVES IN STAIR STRINGERS WHERE THEY SPLICE TO TOP OR ANOTHER SECTION
1½
NOTE: IF WALL IS GRADED UNDER STAIRWAY, TAMP THOROUGHLY TO GIVE A FIRM, SOLID BEARING. WALL SLOPE MUST BE 1½:1 WHERE STAIRS ARE INSTALLED.
ELEVATION
¼" STEEL PLATE
⅝" NUTS
TWO STAIR SECTIONS

Methods Used to Salvage And Recondition Old Line Pipe and Fittings

by Steve Terrell*

THERE is a wide divergence of opinion among pipe-line organizations in regard to economy of recovering and reconditioning long-buried pipe and fittings, but experience and observation in replacing limited sections of corrosion-troubled line in the past has convinced us that it is a profitable operation. For several years we have been developing our own method of conserving our pipe and equipment as simply and as practically as possible at Edna, Tex., where a machine shop, sandblast equipment and a large pipe yard are maintained. We claim no originality in our methods, nor do we claim perfection; what we have achieved has been by trial and test, and we expect to revise our system as our future errors shall direct. We offer our procedure in the hope that it may help somewhere in this tightening-up era—it has helped us in the "pulling up of our belts."

On arrival at our yard for reconditioning all crooked pipe is culled before racking and straightened in a hydraulic press to facilitate handling. From truck-high racks the pipe is first rolled onto angled rollers where it travels between gas fired nozzles that heat it just below redness. This burns off the old paint, asphalt, coal tar pitch, grease, etc., and loosens the rust for fast cleaning. After traveling by a fixed sandblast nozzle, the angled rollers propelling the pipe forward and rolling it at the same time, the pipe is inspected and the pits ringed with yellow lumberworker's crayon. The pit holes that are ringed depend on their depth (usually about 135 mils), the area of the pit, and the thickness of the pipe or working pressure. Some places not suitable for repairs are marked for cutting out. A welder then takes over and spot welds (metal replaced by electric welding) the ringed pits. The pipe is then graded and stenciled 1, 2, 3 or 4. The first three grades are beveled 30° with an oxygen-acetylene beveling machine. The fourth grade we ordinarily use for casing smaller lines or for making shop-made clamps. The short joints and pieces are welded into approximately 40-ft. lengths with one stringer and two filler beads run at each weld, the pipe being turned on a set of rollers. When holes are repaired a crossed-beaded weld is used. Pipe, 12 in. or larger, is primed one joint at a time with a spray gun, but smaller pipe is painted several joints simultaneously, the joints laying side by side. It is then ready for service and if care has been taken, the operations

*Chief warehouseman, Houston Pipe Line Co.

Sturdy in every part

THICK body walls, heavy flanges, large bolts, and deep stuffing boxes are characteristic of every Kennedy Valve type. Operating mechanisms are simple, strong and positive in operation, stems are of specially tough metal, and handwheels are amply large for easy leverage.

Whether you require valves for low, medium, extra heavy or hydraulic pressures, you will find an exactly suitable Kennedy Valve type which has proven its reliability in many thousands of installations in the oil and gas industry.

THE KENNEDY VALVE MFG. CO. . . . . ELMIRA, N. Y.

Fig. 177
1000-lb. Test

Fig. 192
1600-lb. Test

KENNEDY

Extra Values in VALVES and PIPE FITTINGS

will more than justify the expense.

Perhaps there is no greater waste in pipe-line maintenance than in the discarding of valves, merely because they leak. A leaky valve is a dangerous mechanism but not necessarily one to be shelved. A heavy-duty lathe and drill press have been of invaluable use to us in repairing gate valves. After sandblasting and disassembling we grind the disk under kerosene, using emery paper on a flat disk attached to the drill press. If necessary a new seat is brazed on the disk and turned in the lathe, or an entirely new disk may be installed. Seat rings are also ground under kerosene with emery paper backed by a machine disk or the valve may be given new seat rings. The stem is inspected and if found to be bent, it is straightened with hammer or hydraulic press. A very common stem trouble is jammed or broken-off wheel-nut threads. It is a simple operation, of course, to build up with brazing rod and run new threads by hand die. On large valve stems we have squared off a new grip for the wheel, drilled a hole down the stem, tapped, and used a cap screw and washer to fasten the wheel. There is an enormous quantity of brass in a large-size stem and we believe it especially commendable at the present time to salvage them. The valve is then ready for reassembling, using new gaskets and packing. It is then tested by hydraulic pressure to one and one-half times the rated working pressure. Primarily this test is to determine whether the newly ground seats are holding and we have found that most reworked valves hold perfectly on first test, but should they be leaking the least bit of water the seats are reground.

Meantime the flanges have been sandblasted and inspected, those undamaged need only to have the nipples beveled 30° on lathe. Quite often we cut the nipples out of the defective ones, insert a new nipple and electric-weld on both sides of the flange. This flange side is then finished off in the lathe. The flanges are then bolted to their companion valve and both valve and flanges painted and placed in warehouse stock.

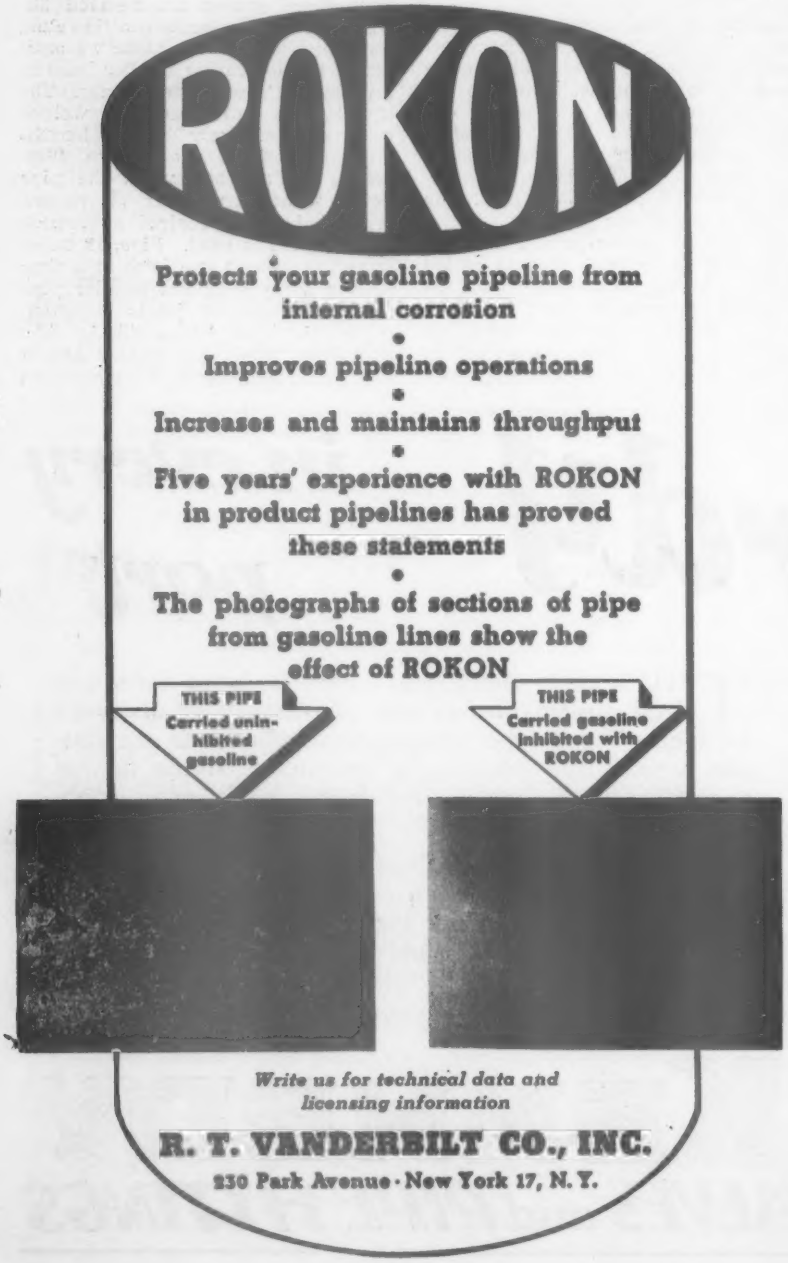
Expansion sleeves are first sandblasted and then inspected; the sleeve is tried on pipe to determine that it has not been flattened. Any deep pits are spot welded. The followers are tested for roundness, and reassembled on the sleeve with new bolts as ordinarily we find it practical, in taking sleeves from a line, to cut the bolts. New gaskets are stocked for the sleeve but not assembled.

Split sleeves are salvaged in much the same manner even to the priming with a spray gun, whereas couplers and clamps are painted by dipping.

Smaller fittings such as ells, tees, collars, etc., are closely inspected and those usable are boiled in a strong alkali solution to remove the paint, cleaned on a buffer wheel and reinspected before placing in stock. Unions, of course, should be tested under hydraulic pressure and if leaking, the seats should be ground.

In a salvage program such as we have undertaken it should be emphasized that the inspection department carries a great responsibility. There are no well-founded rules to govern it, except that which dictated the words—look closely. We found by experience that a small quantity of mercury blown into a line from an orifice meter can affect the brass in the stem of a valve and that it takes close inspection to discover the slight grayish cast that indicates a defect. We look to inspection for the flexibility of running high-test fittings in lower pressured lines. Equipment that production men would be unwilling to place in a high-pressure line may give years of satisfactory service in some other field, as perhaps a compressor station water line or a low pressure distribution system.

Farsighted companies will look into every effectual means of getting the most efficiency from their equipment in the next few years. It is a practice that will pay dividends and is not unduly arduous.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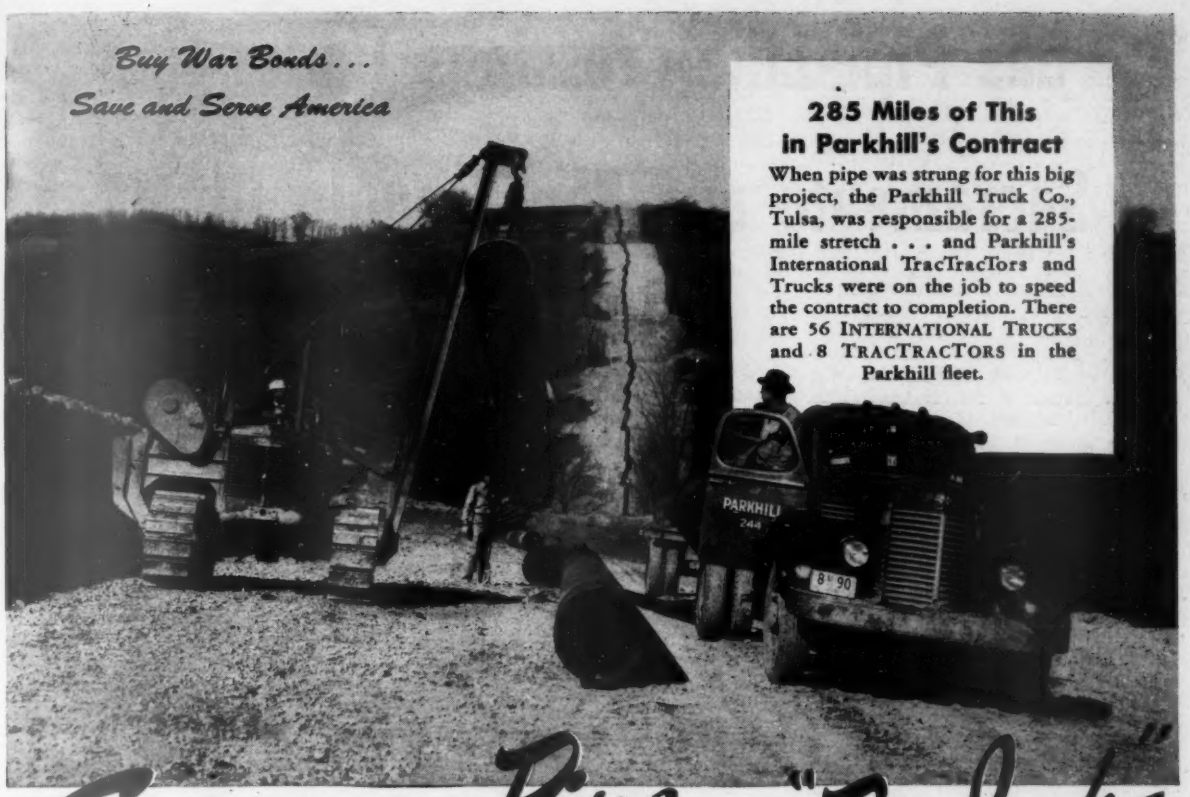


285 Miles of This in Parkhill's Contract

When pipe was strung for this big project, the Parkhill Truck Co., Tulsa, was responsible for a 285-mile stretch . . . and Parkhill's International TracTracTors and Trucks were on the job to speed the contract to completion. There are 56 INTERNATIONAL TRUCKS and 8 TRACTRACTORS in the Parkhill fleet.

Stringing Pipe on the "Big Inch"
with INTERNATIONALS Out in Front

EASTWARD IT MOVED—1,341 miles of pipe line from Texas to New Jersey. That was "Big Inch," laid in 42-foot lengths that weighed two tons apiece. It was a tremendous operation and it was RUSH. Contractors, like the Parkhill Truck Company with its fleet of International TracTracTors and Trucks, helped complete this vital wartime project in an unbelievably short length of time.

INTERNATIONAL Tractors and Trucks came through on this job. Count on them—and on International Power Units—to carry on wherever and whenever pipe must be strung and laid, wells drilled and pumped, and petroleum products refined and delivered to users.

THE ARMED FORCES have first call on International Equipment today. Your present tractors, engines and trucks will probably have to last for the duration. Give watchful, eagle-eye attention to care and maintenance. Make International Service—available at well equipped, well manned International dealers' shops—your ally in keeping your equipment working.

INTERNATIONAL HARVESTER COMPANY
180 North Michigan Avenue Chicago 1, Illinois

Gas Pipe-Line Crossings Under the Sacramento and San Joaquin Rivers

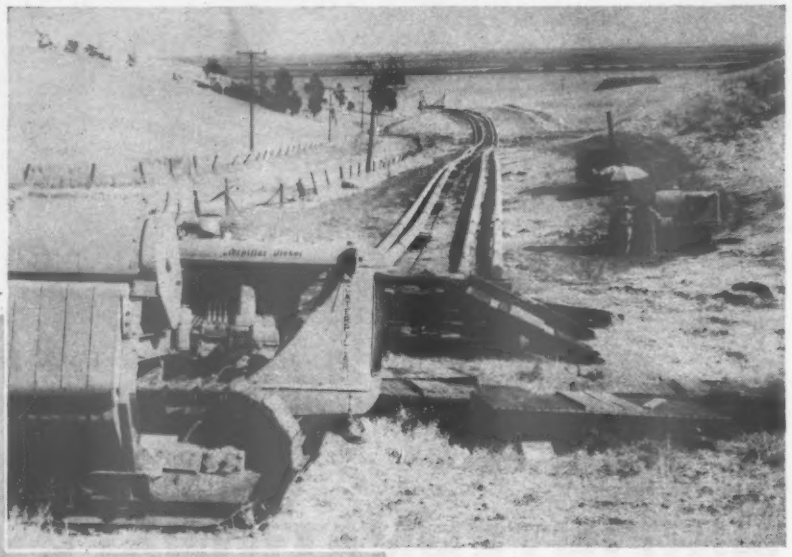
*by J. A. Love**

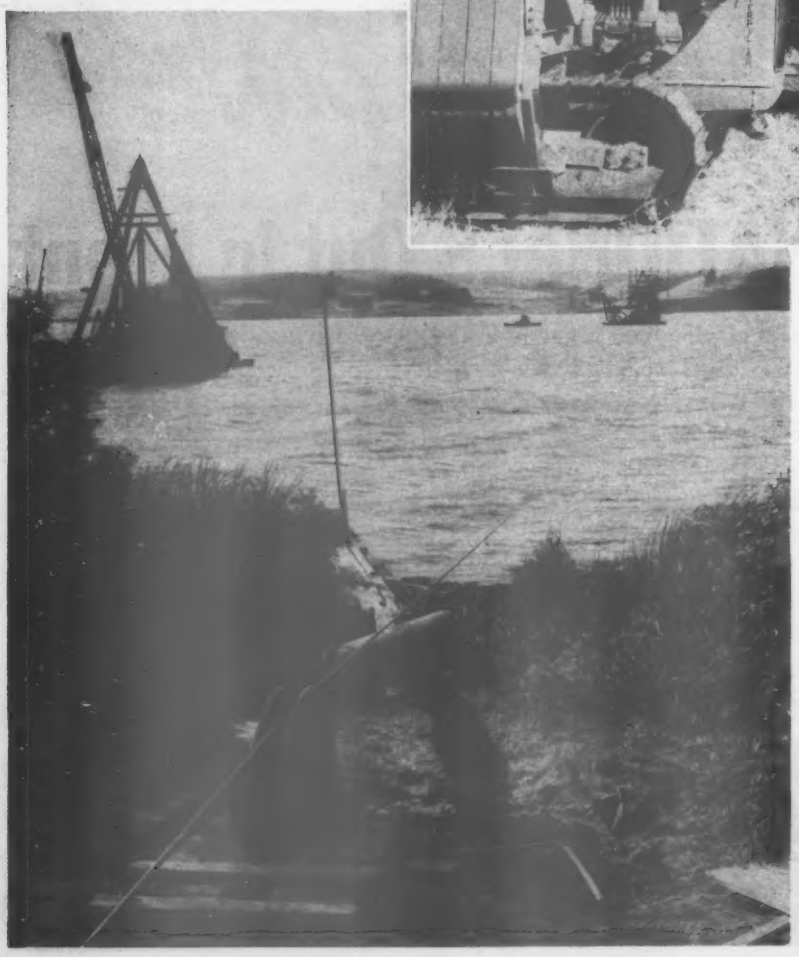
THE Pacific Gas & Electric Co.'s 1942 program for Natural Gas expansion included the construction of three under-water pipe-line crossings. The three installations were a part of the collecting and transmission system in the Rio Vista natural-gas field.

The field, extending in a general direction from west to east, is divided by the Sacramento River. The west field lies in rolling hills on the mainland; the east field lies in a series of islands formed by the convergence of the Sacramento, the Mokolumne and the San Joaquin rivers; two of the islands so formed are Bradford and Sherman.

Pipe capacities of our collecting and transmission system required that a 10-in. pipe line 2,140 ft. in length be constructed under the San Joaquin River between Sherman and Bradford islands; two parallel 12-in. pipe lines each 3,281 ft. in length under the Sacramento River from Sherman Island to the mainland; and, three parallel 12-in. pipe lines each 3,908 ft. in length under the San Joaquin River between Sherman Island and the mainland to the south.

*Assistant Engineer, general construction department Pacific Gas & Electric Co.





Above: The 12-in. pipe sections lined up, the second from the left in place on the cars, and ready to be pulled across the Sacramento River, a distance of 3,281 ft. These sections formed a double line across the river. Left: One 12-in. pipe is in place across the Sacramento River and the second is being pulled across. The small barge supporting the end of the pipe can be seen in midstream.

The topography of the land in the region permitted a common method of installation to be used at the three river crossings.

The rights-of-way were located very favorably from the standpoint of a minimum amount of interference and it was possible to utilize a strip of land varying in width from 40 to 100 ft. and extending 2,000 ft. inland for construction purposes.

The first right-of-way to be ac-

Above: Sending the diver down to inspect the pipe lines across the river. Right: The 10-in. pipe lined on the cars and ready to be launched under the San Joaquin River. The trestle for the tracks was built up from the skids available from recent pipe-line construction in the vicinity.

Right, bottom: The tractors hooked up in tandem were used on the north side of the 3,908-ft. San Joaquin River crossing and pulled straight across country.

quired was at the San Joaquin River and equipment was immediately moved to that location and all phases of the work started.

The planned procedure was to prepare the pipe in long parallel strings in the working strip and, in order to prevent damage to the protective coating on the pipe, move the pipe on narrow-gage cars from the working strip to the river.

Along one edge of the construction strip a 24-in. gage track was constructed with 30-lb. rail on a flat grade with the exception of a short curved section at the river levee. The gradient in this section dropped sharply to permit the removal of small flat cars.

The flat cars were 40 in. wide and 72 in. long with plank deck and mounted on 12-in. diameter steel wheels. The cars were placed on the track at intervals of 40 ft. in readiness to transport the pipe without damage to the protective coating.

Double random lengths of heavy-wall seamless steel pipe arrived on the job with a factory-applied coat of Somastic. The Somastic coat averaging ⅝-in. thick served as a protective coat against corrosion and added 20 lb. per ft. to the weight of the pipe.

Side-boom caterpillars unloaded the pipe from trucks placing the sections end to end parallel to the launching track. To prevent damage to the Somastic coat a sack of sand was placed as a cushion between the pipe and the skid.

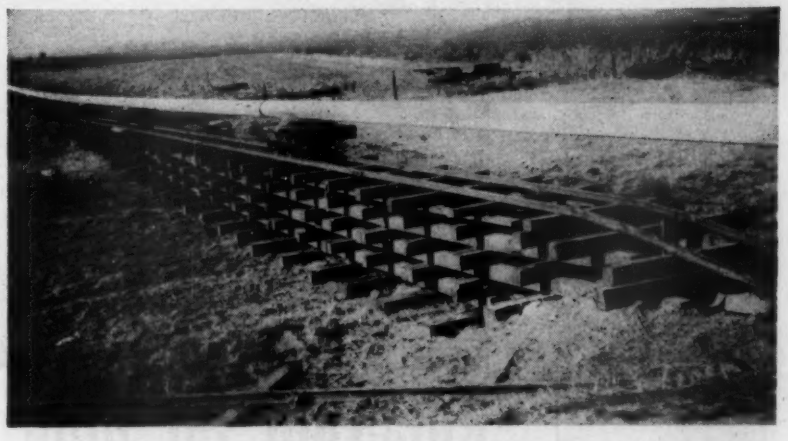
In the double and triple 12-in. crossings the pipe was arc-welded to form sections equivalent to slightly more than half of the distance across the rivers, i.e., approximately 2,000-ft. sections for the San Joaquin River crossing and 1,600-ft. sections for the Sacramento River crossing. The 10-in. pipe line from Sherman to Bradford was made up in a single section 2,140 ft. in length.

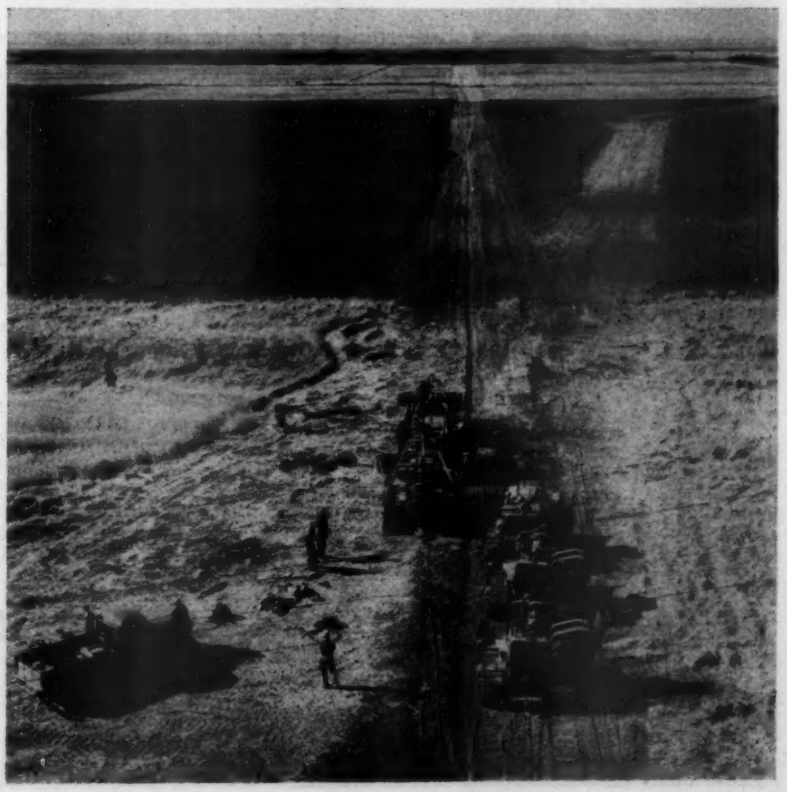
All of the welded joints in the long pipe section were given a soapsuds test for leaks followed by a 24-hr. chart test with air at 100 lb. per sq. in.

The trenches for the pipe in all the crossings were excavated with dredges equipped with 5-yard clamshell buckets which also were used for back-filling. On the San Joaquin and Sacramento rivers crossings the trenches were excavated at a grade to maintain a specified minimum of 5 ft. of covering over the pipe. The water depth in these two crossings varied from a minimum of 12 ft. in both streams to a maximum of 28 ft. in the Sacramento River and a maximum of 36 ft. in the San Joaquin River.

Coordination of the work was such that the dredging of the trench across the river was completed 1 day in advance of the completed pipe sections.

A steel cable was dragged across the river with tug boats and fastened to the bullheaded end of the





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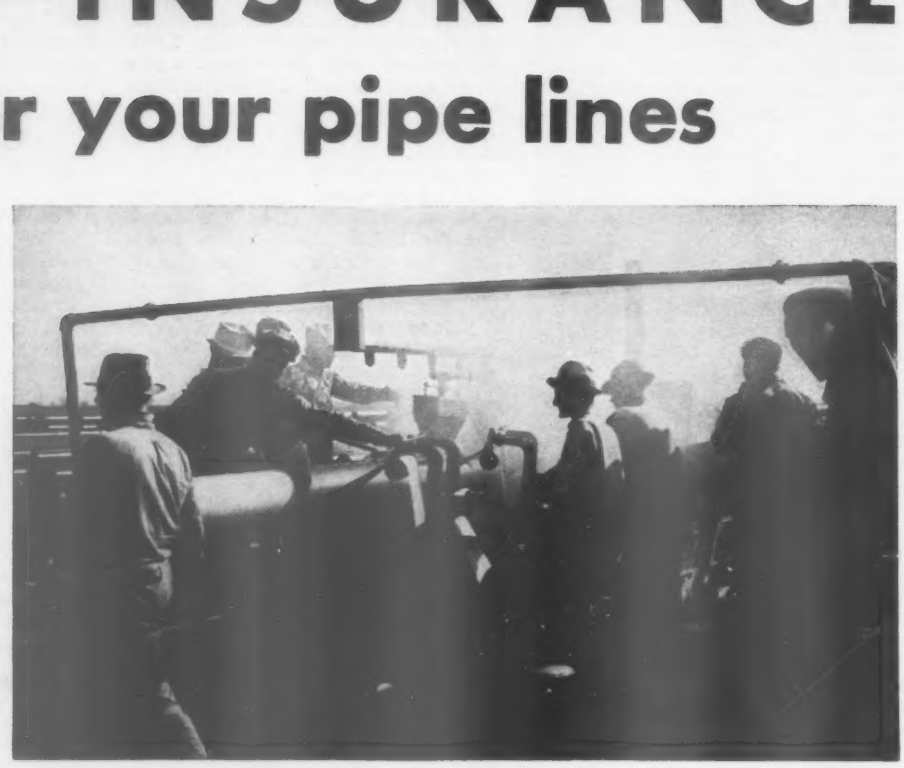
for your pipe lines



Ruberoid for pipe line protection

● Ruberoid research has developed a superior asbestos felt for greater protection of pipe lines . . . increasing their life and service. This ideal material, called Imperial Asbestos Felt, is chemically inert, moisture-resistant and affords protection from electrolysis. Pipe can be either mill or field wrapped with great facility and efficiency.

The use of Imperial Asbestos Felt with Imperial Pipe Line Primer and Imperial Pipe Line Enamel assures maximum protection under the most severe conditions. For more details write for Industrial Bulletin "E."

The RUBEROID Co., 500 Fifth Ave., New York 18, N. Y.

1. Imperial Pipe Line Primer

For use under Imperial Enamel, or as a light preservative coating on lines subject to mild conditions. Also recommended as a shop coat.

2. Imperial Asbestos Felt

For use when soil conditions require further protection of the coating or enamel. Imperial Pipe Line Felt is tar-saturated, highly adhesive.

3. Imperial Pipe Line Enamel

Water repellent, waterproof, chemically inert. Bonds at all temperatures. Coal tar base reinforced with asbestos fibres. Durable, unaffected by age.

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RU-BER-OID PIPE LINE MATERIALS

leading pipe section with a swivel connection. The leading end of the pipe was also suspended by a cable from a small steam winch mounted on a derrick barge. In this way the bullheaded end of the pipe was prevented from digging into the mud. With the derrick barge the pipe end was held close to the bottom by slacking off or taking up on the supporting cable to compensate for the depth of water. The derrick barge was dragged across the river with the end of the pipe. A tugboat was kept alongside the derrick barge during the pull to keep the barge and pipe in proper alignment against the river current which varies with the tides in San Francisco Bay.

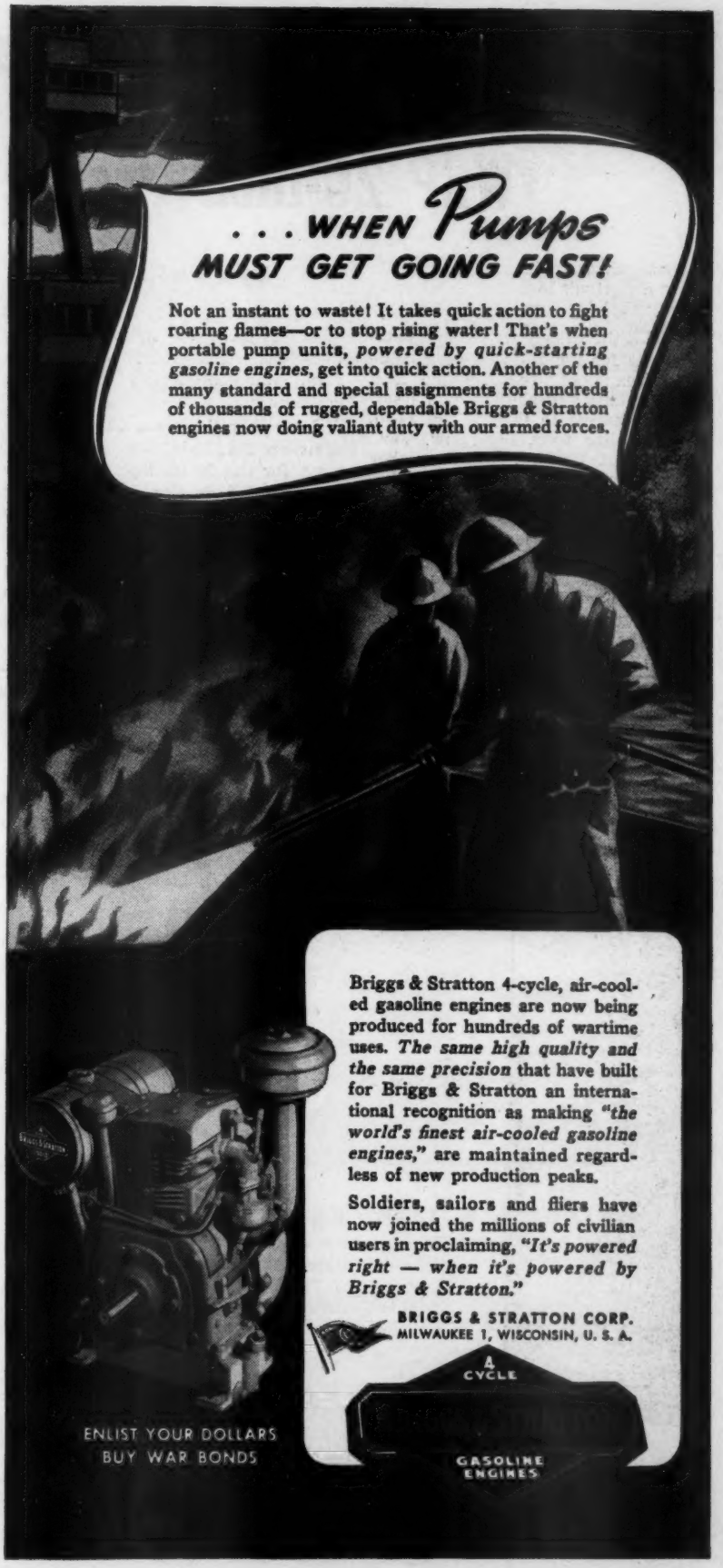
As each section of pipe was being launched the flat cars were removed at the low spot and replaced along the track to make ready for the next long section. Progressively the sections were pulled into the river with a stop made for welding, testing and treating one field joint for each 12-in. pipe laid across the San Joaquin and Sacramento rivers. On the 2,140-ft. crossing of 10-in. pipe under the San Joaquin River the entire length of pipe was pulled without a stop.

The pulling power was derived from caterpillar tractors hooked up in tandem and fastened to the pulling cable on the far side of the river. At the triple crossing of the San Joaquin River it was possible to walk the caterpillars across country in a straight pull. At the other two crossings the caterpillars walked along the river levee pulling at right angles to the pipe crossing by means of rigging the pulling cable through a snatch block fastened to a dead man on the levee.

A final inspection of the pipe lines on the bottom of the trench was made by a diver who inspected for spacing between lines, to see that no bridging of the pipe occurred over pot holes and that the protective coating was intact. At numerous locations in the several crossings the diver found it necessary to move sections of the pipe to get proper separation in the pipe lines. This operation proved to be quite simple. The diver attached the lifting tackle of the derrick barge to the pipe and gave instructions by telephone as to direction in which to move the pipe.

The pipe being in proper alignment in the trench the dredges started backfilling. The backfill material was dug from the river bottom in such manner that a minimum amount of disturbance occurred in the river channel.

All of this work was done under the general direction of O. W. Peterson, engineer of general construction, Pacific Gas & Electric Co.; and, all field supervision under the direction of A. D. Spratling, assisted by J. A. Oldham, R. E. Wetter and W. W. Welter.


. . . WHEN Pumps MUST GET GOING FAST!
Not an instant to waste! It takes quick action to fight roaring flames—or to stop rising water! That's when portable pump units, powered by quick-starting gasoline engines, get into quick action. Another of the many standard and special assignments for hundreds of thousands of rugged, dependable Briggs & Stratton engines now doing valiant duty with our armed forces.
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Design of Pump Stations on the WEP 20-Inch Products Line

by Paul Reed

WHILE the design of the pump stations for the 20-in. products line from Beaumont, Tex., to the East Coast is basically similar in a number of respects to that of the 24-in. crude-oil line from Longview, Tex., to the East Coast, a large number of departures have been made because of the different nature of the service to be performed and because of certain lessons learned from experience in the operation of the 24-in. line. Stations for the 20-in. products line have been designed by F. E. Richardson and L. F. Scherer under the direction of Oscar Wolfe, chief engineer, War Emergency Pipelines, Inc. A. S. Munneke and J. L. Gates handled design of electrical equipment.

Altogether there are 26 pump stations on the 24-in. line and 29 stations for the 20-in. line. Both lines are operated as closed systems. At present special effort is being made to complete five stations located at Beaumont, Tex.; El Dorado, Ark.; Little Rock, Ark.; Fagus, Mo., and Oran, Mo., for handling shipments to Norris City, Ill., for movement by tank car from there to the East Coast before the remainder of the 20-in. line is completed.

From Little Rock eastward stations for the 20-in. line are located within a few hundred feet of the stations of the 24-in. line. It is anticipated that when stations for both lines are in operation there will be a chief engineer in charge of both stations at each point; an operating engineer in charge of a shift will be selected at both the 24-in. and 20-in. stations at each location who will have the title of chief engineer of his particular station.

The 20-in. line is intended to han-

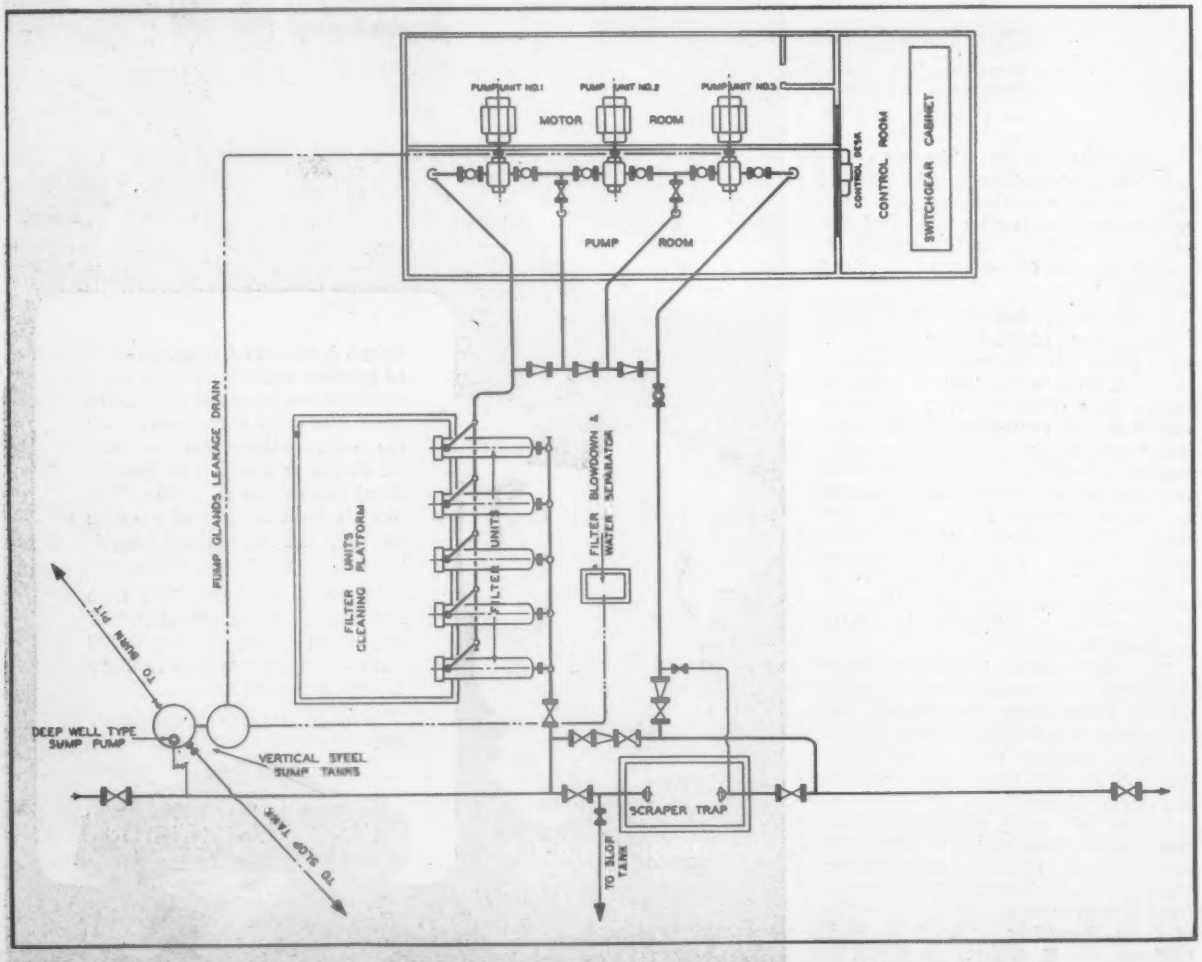
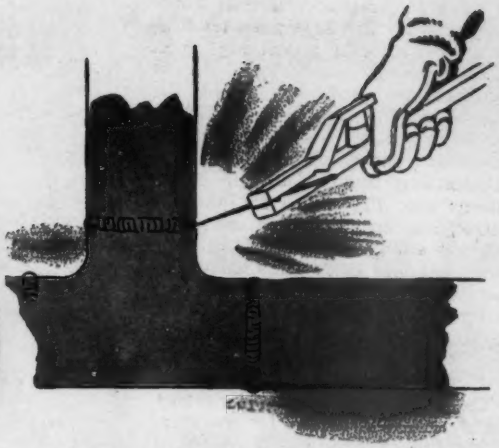


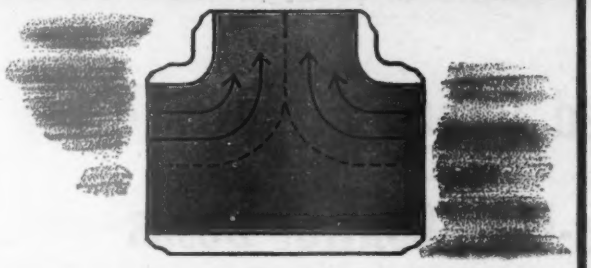
Diagram of pumping units, piping and buildings of a typical WEP 20-in. products line station

How TUBE-TURN welding tees improve piping construction



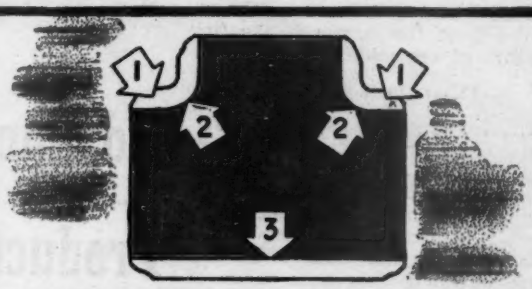
LONGER OUTLETS SPEED WELDING

More room for easier manipulation of rod means faster welding and better, sounder welds.



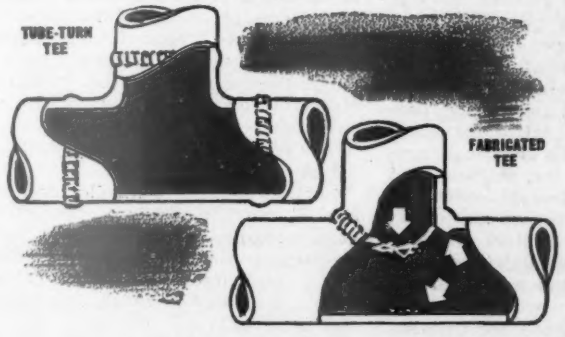
SMOOTH FLOW, LESS PRESSURE LOSS

Smooth inner walls assure even flow and reduce wear. Rounded inside crotch reduces pressure loss.



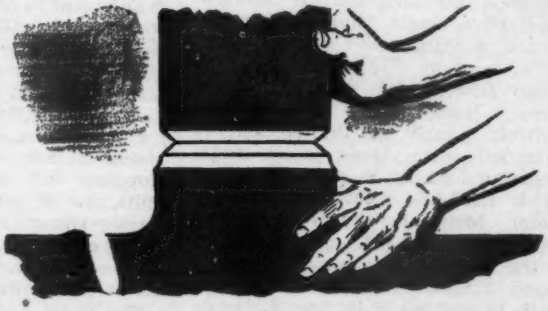
EXTRA STRENGTH AT STRAIN POINTS

Added thickness at top of run (1), crotch (2) and bottom (3) strengthens points of highest stress.



NO FABRICATION FAULTS

Fabricated tees often have jagged corners, crude welds, and slag. Tube-Turn Tees eliminate these.



FASTER, EASIER ALIGNING

Accurate bevels, plus I.D. and O.D. that exactly match the pipe, make aligning simple and speedy.

TUBE-TURN
Welding Fittings and Flanges
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HOW TUBE-TURN WELDING FITTINGS BENEFIT WAR INDUSTRY
The FIRST WELDING FITTINGS 1ST

dle as high as four different kinds of products in separate tenders, batches or blocks, depending upon the terminology used by different organizations. However, during the early stages of operation the 20-in. line will probably only handle heating oil and one grade of gasoline.

Distinctive features of the 20-in. stations are: Provisions for throttle control, sequence starting and stopping of units, special control-room equipment and filter units known as "hay tanks" for removing suspended matter before it reaches the pumps.

Settling equipment known as scale traps which has been used on some products lines, has not been adopted for the WEP 20-in. line for the reason that if it were adequate for the great volumes to be handled, it would be too cumbersome to be practicable.

An inhibitor will be used, according to reports. Even with an inhibitor, a considerable amount of suspended matter will probably be removed from the stream in the first 2 years of operation.

Filter Units Elevated

The five filter units at each station are supported 2 ft. above a concrete platform at a height which will be convenient for removal of excelsior from strainers by special dollies when it is necessary to clean.

In designing the WEP 20-in. stations, advantage has been taken of the experience of the Shell Oil Co., Inc., and Plantation Pipe Line Co. operation in transporting refined products.

Suction and discharge valves of each pump are motor-operated. A complete pumping unit is manipulated by a single "start-stop" push-button installation.

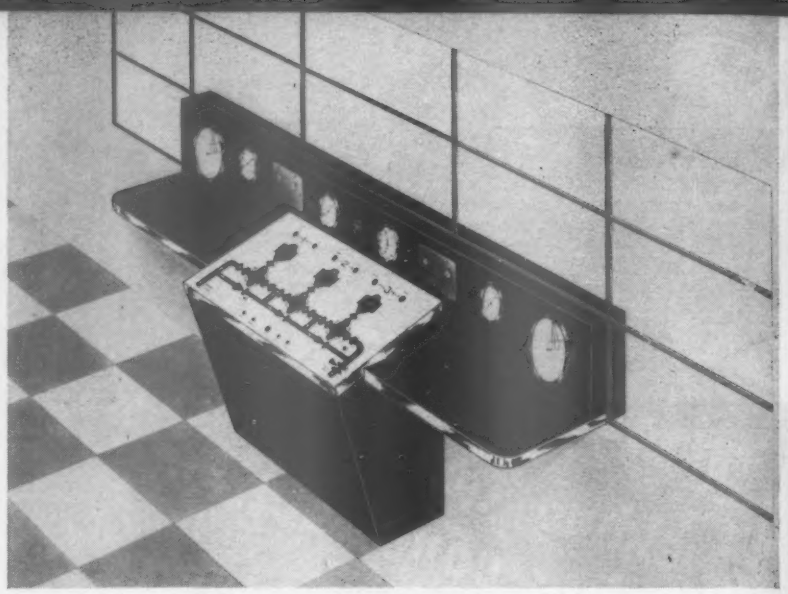
The controls consist of: (a) pneumatic flow control valves, and (b) mercoid temperature and pressure controls. Each of the stations is equipped with three single-stage, centrifugal pumps in a series, driven by a 1,250-hp., 3,600-r.p.m. electric motor. Motors for the 24-in. stations are 1,500-hp., 1,800-r.p.m Capacity of the 24-in. line is regarded as between 315,000 to 325,000 bbl. daily, while that of the 20-in. line is considered as 235,000 bbl. daily.

Considerable attention has been given to locating stations so as to take advantage of terrain in order that drainage may be to the line from the stations. In carrying this out, three piping plans have been prepared which would meet most of the topographical conditions encountered. The accompanying drawing is basically typical of all stations.

Care has been taken to design piping so that there will be no pockets when all three units are operating.

From an 18-in. header, connected with the incoming 20-in. line, prod-

(Continued on page 160)



Control desk with illuminated station diagram equipped with signal lights and start-and-stop push buttons installed in connection with gage panel set in partition between control room and pump room. Gage panel has suction pressure controller and recorder, suction pressure indicating gage, pressure gage for control air, air pressure regulator adjusting knob, clock, discharge pressure indicating gage, discharge pressure controller and recorder

Advanced Design Features WEP Products-Line Control Desks

by M. A. Hyde*

IN each of the 29 stations of War Emergency's 20-in. products line a control desk will serve as the nerve-center for station operation. This desk (1) is the location point for hydraulic instrumentation and control, (2) provides push-button control for automatic sequence of the electrical operations incident to the starting and stopping of individual pumping units, and (3) provides an alarm and visible annunciator system whereby the operator is immediately advised of the occurrence and nature of abnormal shutdowns.

The desk is designed for installation in a partition between the control room and pump room. A large glassed area surrounds the desk, permitting the operator to have a good view of the pump room. To improve this view the gage-panel section is designed low, so that the operator can look over the top of the unit. The gage panel consists of a compartment having doors opening into the pump room and a panel surface facing the control room, on which the instruments are mounted with gaskets. The gage panel is gasketed into the partition to prevent seepage of hazardous vapors into the control room, and as an additional precaution the control room is kept under a small pressure of clean air drawn from the outside of the building. Hydraulic and air piping to the instruments enter through the bottom to the rear of the gage compartment.

Instruments consist of:

Suction-pressure controller and recorder, suction-pressure indicating gage, pressure gage for control air, air-pressure-regulator adjusting knob, clock, discharge-pressure indicating gage, discharge-pressure controller and recorder.

A horizontal surface below and at each end of the gage panel provides writing space and accommodates the station log sheet.

The electrical-control desk mounts push buttons and indicating lights for the master station control, these electrical items and their wiring connections being entirely operated from the gage-panel compartment. The control desk top surface is a sheet of transparent plastic, backed with a schematic design of the main piping within the station. In this diagram are shown the three main-line pumps and their 1250 hp. driving motors.

The suction and discharge valves

*Petroleum industry engineer, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

Baash-Ross News

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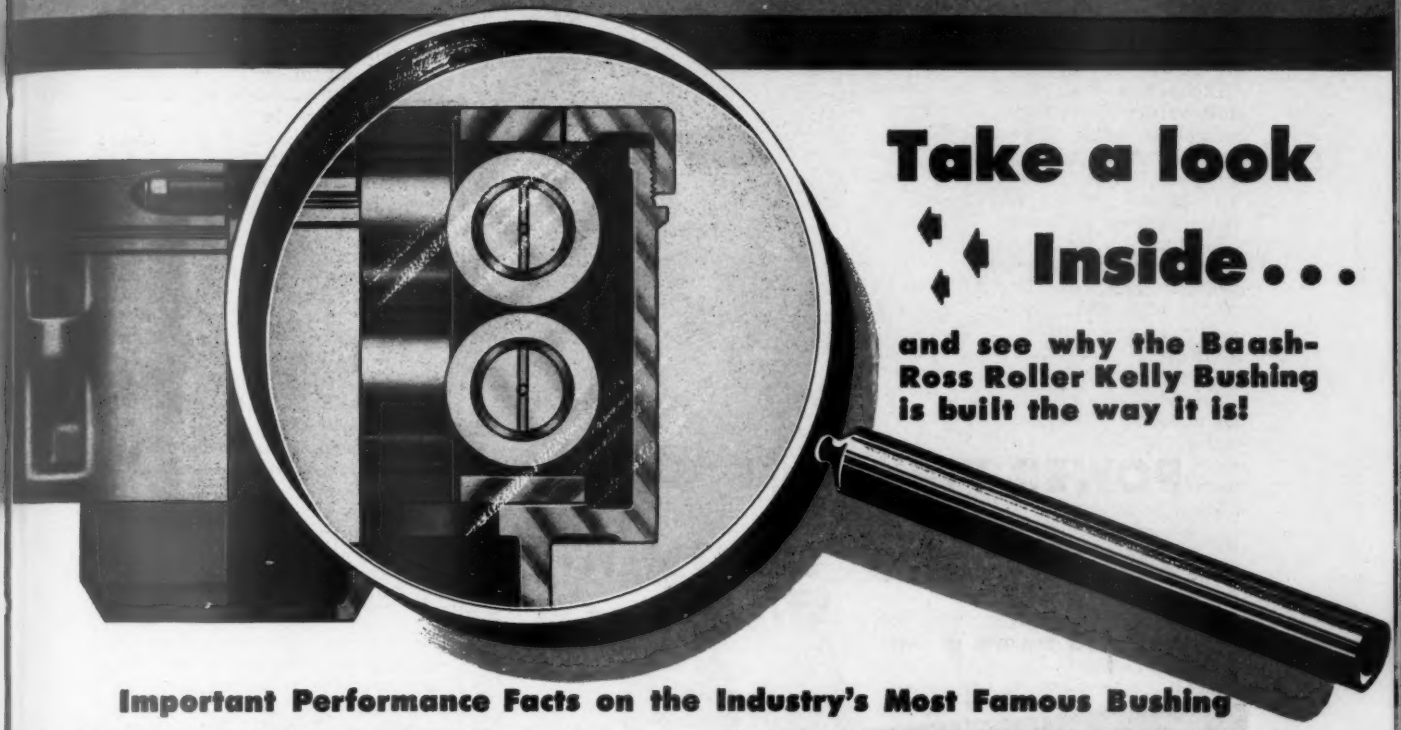


Take a look Inside...

and see why the Baash-Ross Roller Kelly Bushing is built the way it is!

Important Performance Facts on the Industry's Most Famous Bushing

Baash-Ross Roller Kelly Bushings are setting such outstanding performance records wherever they are in service that a constantly increasing number of oil men are asking for more information on the "fine points" of roller bushing design. The following are typical of questions we are frequently asked in the field. Perhaps your question is answered here. If not, our engineering department will be glad to explain to you the engineering "why" of any point you wish to ask about.

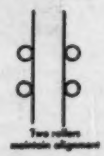
Q Why use *two* rollers in contact with each kelly face? Wouldn't one large roller on each face serve as well?

A. Definitely not. Two rollers give vertical stability to the kelly—prevent it from gyrating and wobbling—hold it steady at *all* table speeds and under *all* drilling conditions, rough or smooth.

One roller on each face would not give this vertical stability . . . would permit the kelly to wobble and gyrate over a wide arc—which, in turn, would not only reduce drilling speed and efficiency, but would also cause severe strains on table bearings, swivel bearings and pipe connections.

Another important point—one roller for each face would necessitate the rollers being quite large in order to prevent "corrugating" the kelly. Large rollers mean high inertia—are slow to start, slow to stop and prevent instant response to kelly feed. But by using *two* rollers against each face, ample driving surface is secured with rollers that are compact, quick-turning, quick-stopping. Result—*instant response to the most delicate bit feed!*

One roller permits wobble



Two rollers maintain alignment

Q Why do you use a bronze bushing between each roller and pin? Wouldn't it be easier to simply use larger pins and eliminate the bronze bushings?

A. It would be easier, yes . . . but not good engineering. The bronze bushings serve a very important function by preventing steel-to-steel contact between rollers and pins. As most engineers know, steel against bronze gives a much better bearing surface than steel-on-steel. It not only resists galling under higher loads, but also carries more efficiently the heavy driving pressures set up between the pins and rollers.

And speaking of the pins, here's another valuable design feature . . . Because there is no pressure (therefore no wear) on the back side of the pins, these have been designed so that they can be easily reversed to bring the unworn back side to the front for additional life after the front sides are worn. Cuts maintenance to a minimum and insures peak performance *longer* without replacements.

Bronze bushing prevents steel-to-steel contact

Q Do you need a separate Baash-Ross Roller Bushing for each size kelly?

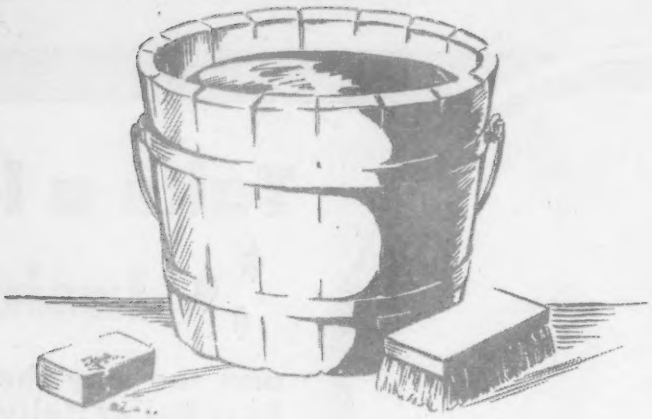
A. No. The same bushing can be quickly changed from one kelly size to another by merely lifting out the roller assemblies—which come in sets—and replacing them with a new set of the desired size. It's simple, fool-proof, quick . . . and cuts kelly bushing investment to a minimum.

For example, the same Baash-Ross Bushing will fit *all* square kelly sizes from 3½" to 6" by simply changing roller assemblies. Or, when using Hex kellys, the same Roller Bushing will fit all Hex sizes from 4¼" to 7" by changing only the assemblies.

Q It's a well-known fact that close bushing fit is important when using Hex kellys. Can you maintain close fit with the Baash-Ross Roller Bushing for Hex kellys?

A. Absolutely! In fact, the Baash-Ross Hex Roller Kelly Bushing is designed so that all you do to adjust the fit is lift out the roller assemblies and remove one or more shims below each assembly. Working diameter is reduced exactly 1/32" for each shim removed, so it's easy to make accurate adjustment without complicated operations.

Get the complete story on Baash-Ross Roller Kelly Bushing advantages before you invest in any bushing. Your near-by Baash-Ross representative will be glad to supply further details on this modern bushing—or write direct for full information.



POWER PIPING GETS THE *Scrub Bucket* TREATMENT

The dangers of reduced efficiency in plant operations due to faulty cleaning of pre-fabricated piping sub-assemblies cannot be too highly stressed. In Associated shops ALL fabrications, regardless of kind, size or shape, undergo our standard cleaning operation. Pipe bends are turbine-cleaned. This assures the dispersement of all foreign matter such as loose dirt, encrusted sand and scale, etc. Clean piping pays dividends. Associated piping is always clean.

Use our organization, experience, skill and most modern equipment, to supply your needs in power piping.

WAR PRODUCTION... This company is engaged in high priority war production, proud of its responsibilities and fulfilling them to the letter.

ASSOCIATED PIPING & ENGINEERING CO., INC.
2332 EAST 38TH STREET
LOS ANGELES, CALIFORNIA

of each pump are motor-operated and the control of these valves is arranged in sequence with the motor starter in such manner that the operator manipulates a single start-stop push button to control the complete unit, the valve-motor control and pump-motor control being arranged to function in proper sequence for starting up and shutting down. Indicating lights in the desk-top diagram show the valve positions, and in addition small illuminated arrows show the actual course of the stream through the station piping in accordance with the particular units operating.

Each pumping unit is equipped with a number of protective shutdown devices, operating in response to excessive temperature in motor and pump bearings, motor winding, pump-case temperature and pump-case pressure. There are also certain station protective features such as low suction pressure, high discharge pressure, overcurrent trip, low air supply to hydraulic controlling, high sump level, and stoppage of blower which pressures the control room. When any of these protective devices functions, a small red indicating lamp appears at the appropriate spot on the station diagram in the desk top, and the operator is given an audible alarm signal. In addition, certain of the protective devices automatically shut down the particular unit involved, or the station. In each case the audible signal continues until it is silenced by an alarm cut-out button and the particular indicating light burns to tell the operator exactly where the trouble is. The indicating light is extinguished by manual reset at the protective device location when the trouble is cleared.

This desk and the associated system of control greatly simplify the duties of the station operator, increase the reliability of station operation, and facilitate location of the trouble spot in case of abnormal shutdown.

Design of Pump Stations On WEP Products Line

(Continued from page 158)

ucts flow through 8-in. connections to five filter units which consist of horizontal tanks filled with excelsior from which products flow through 8-in. connections to an 18-in. header which is swedged down at the station to 14-in. pipe at the suction end of No. 1 pump from which it passes through a 12-in. discharge valve. The other two pumps are equipped with similar connections. Bypass lines to the station manifold are 16-in. In the station manifold, there are three check valves. Another check valve is located in the 16-in. discharge line from the station, close to a gate valve

DIET: ENEMY TANKS *-and* GASOLINE

The Gauge with the "RECALIBRATOR"

Illustrated here is the Marsh Mastergauge, a gauge that brings new meaning to accuracy and stamina with its precision-built movement and bourdon tube bored from solid bar stock. That "Recalibrator" makes it the ideal gauge for today's needs, because it means that accuracy is locked in for keeps. If ever the gauge is knocked out of adjustment, a twist of the "Recalibrator" screw makes it accurate again at all points on the dial—something that has never been satisfactorily accomplished before.

★ The Army's M-10 Tank Destroyer is a killer — with plenty of speed, a thick tough hide, and a real Sunday punch. It was this type of weapon that helped to set the pattern for victory in Tunisia.

American ingenuity and hard work built this M-10. Fighting Yank soldiers are demonstrating its deadly power. And plenty of the world's finest gasoline, from America's great oil industry, will keep it thundering on its way.

In producing this gasoline, and all the other petroleum products so vital to a nation at war, the oil industry is doing a tremendous job. It's a job that calls for all-out effort, from men and equipment alike, from *all* industry.

Marsh Gauges have a share in this responsibility. There are thousands in service—in refineries and cracking plants, on pipe lines, all over the oil fields. Each one is proving anew the greater accuracy and stamina that has resulted from Marsh's 75 years of gauge-making. Each one is adding to an already great service record.

JAS. P. MARSH CORPORATION, 2065 Southport Avenue, Chicago 14, Illinois

MARSH GAUGES

near the point where this line is connected with the 20-in. main line leading from the station. On the station bypass, there is a gate valve on each side of the check valve.

Each large valve at the 20-in. stations is supported by a jack instead of being grouted in concrete like the large valves of the 24-in. crude-oil line.

Small piping of drain lines of the 20-in. stations is different from that in the 24-in. crude oil stations. This has been arranged so as to eliminate excessive loss of products to the sump. This is done by installing gate valves and check valves in such a way that a large part of the leakage is taken directly into the suction end of the station without going into the sump.

Drainage from the filter units and from the station floor goes by gravity to the vertical steel sump tanks. Products are moved from these sump tanks by a standard deep-well pump of a type used by the Army and Navy for lifting products from underground storage. From the sump tank products can be pumped to the burn pit or back into the line, if authorized by dispatcher's orders. An attempt will be made to keep the sump tanks as dry as possible. Slop from the scraper trap will go to a slop tank from which it can be disposed of as ordered by the dispatcher.

Control equipment for the WEP 20-in. products-line stations has been selected with consideration for both the service to be performed and the supply conditions under which it must be procured in wartime. Such equipment will not be as elaborate as that of some of the principal products lines built in recent years. Compared with that of the WEP 24-in. crude-oil line, control equipment on the 20-in. products stations will be much more extensive. In the operation of the line it will simplify responsibilities of personnel and make it easier to locate trouble which may result in abnormal shutdown of equipment.

The principal features of the 20-in. station-control equipment are: (a) Throttle or flow control which operate through pneumatic equipment to shut down the motor-operated discharge valve of the station when suction pressure drops below 30 lb. or pump case pressure rises to 1,000 lb. or line pressure is excessive (between 850 and 900); (b) mercoid temperature and pressure controls.

The central point of the control system of each station is the control desk and gage panel located at the partition between the control room and the pump room. Through a large glassed area in the partition, the operator can observe the pumping equipment. The control desk has a small diagram of the main station piping and the three pumps and their motors. This diagram is illuminated with red, yellow and green lights to indicate the status of operating conditions. Lights show valve positions and the location of abnormal pressure and temperature conditions. Illuminated arrows indicate the direction of flow through the piping. Details of the control desk and gage panel are described by M. A. Hyde, Westinghouse Electric & Mfg. Co., in this issue.

As a safety measure the floor of the control room is raised slightly above the level of the station floor. Air pressure within the control room is maintained slightly above atmospheric (at about ½ in. of water). Air for the control room is drawn from outside the building. A ventilating feature, which has demonstrated its value on the 24-in. line, is the cooling of main motors by means of a fan and large air duct at each motor, to be installed at all stations of the 20-in. line.

Mercoid devices, for protecting station equipment from damage due to high temperature, function as follows: When the temperature of a pump casing or a motor or pump bearing rises excessively, the unit is automatically shut down, with horn and red-light signals notifying the operator of the occurrence and

As a built-in power unit on portable or mobile equipment, you'll have to look a long time before you can out-point this Model VE-4, V-type, 4-cylinder, Wisconsin Air-Cooled Engine.

This husky heavy-duty "lightweight" checks in at 285 lbs. and delivers 22 hp. at 2600 rpm. Other Wisconsin Air-Cooled engines (from 1 to 31 hp.) are equally adaptable to a great variety of applications where light weight is wanted, without sacrificing heavy-duty serviceability.

MOST POWER PER POUND

WISCONSIN MOTOR Corporation
MILWAUKEE WISCONSIN U. S. A.
World's Largest Builders of Heavy-Duty Air-Cooled Engines

WRITE TO HARLEY SALES CO.
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M & M BLDG., HOUSTON, TEXAS
OIL FIELD DISTRIBUTOR FOR WISCONSIN ENGINES AND ALL TYPES OF UTILITY UNITS

A Name To Remember Post-War

GATX GENERAL AMERICAN
PLATE & WELDING DIVISION
PLANT AT SHARON, PA.

NOW AT WORK 100% FOR VICTORY

Steel plate fabricators

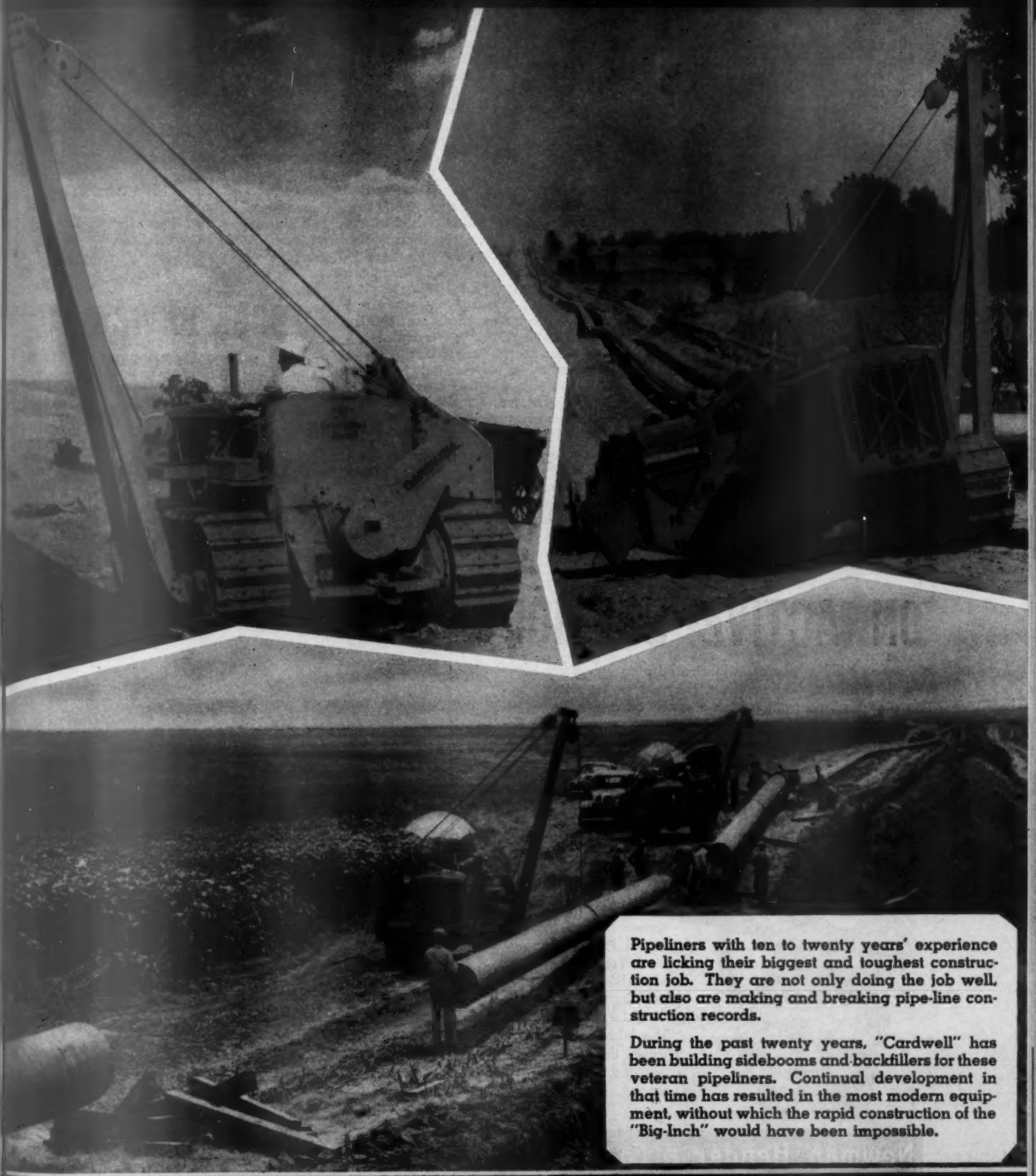
Manufacturers of Class I pressure vessels and all other classes of welding

Complete X-ray and annealing facilities

Completely equipped department for field erection

Plate and Welding Division
GENERAL AMERICAN TRANSPORTATION CORPORATION
SHARON, PA.

VETERAN PIPELINERS AND MODERN EQUIPMENT MAKE THE "BIG-INCH" POSSIBLE



Pipeliners with ten to twenty years' experience are licking their biggest and toughest construction job. They are not only doing the job well, but also are making and breaking pipe-line construction records.

During the past twenty years, "Cardwell" has been building sidebooms and backfillers for these veteran pipeliners. Continual development in that time has resulted in the most modern equipment, without which the rapid construction of the "Big-Inch" would have been impossible.

CARDWELL ALLSTEEL

THIS TRADE MARK INSURES HIGHEST QUALITY AT LOWEST PRICE

CARDWELL MFG. CO. INC.

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P.O. Drawer 2001 Cable Addresses: ALLSTEEL, WICHITA — CARDSTEEL, NEW YORK

Wichita, Kansas, U.S.A.

EXPORT OFFICE

570 Lexington Avenue

Phone Plaza 5-9325

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New York City, N. Y.

location of the trouble. If a motor winding becomes too hot, only warning signals are given so that the operator may unload the pump and let it roll.

In cases of abnormal temperature or pressure at one of the three main pumps, the same thermostat or pressure relay that turns on the red signal light, causes protective devices to function which automatically stop the electric motor and close valves leading into the pump and causes other valves to open so as to route the flow of refined products through the station manifold around the idle unit.

The station is also safeguarded by protective devices which function under the following conditions: (a) low air supply for pneumatic equipment for hydraulic controllers; (b) high sump level; (c) stoppage of blower which maintains pressure of air in control room. The motors are protected by an overcurrent trip.

Sequence-starting operations are begun when the operator pushes a button at the control desk. By this method trouble is avoided which may occur when an operator becomes confused while handling the various steps separately by manual manipulation. Limit switches or direct-acting relays are used for sequence starting of the 20-in. stations instead of timing relays used on other products lines. Among the lessons learned from experience of other products lines is that of the importance of ruggedness in all control equipment.

The starting of units of the 20-in. stations will be handled by push-button control which makes automatic sequence starting possible. A unit is started with sequence starting in the following manner: After provision has been made for proper suction pressure on a line, the discharge control or controller is adjusted to demand pressure. Then a push button operates the pump suction valve. When it has reached the open position, it closes the contact which starts the motor. When the motor has reached running speed it automatically begins to open the discharge valve at which point the automatic control takes over. When the first unit has been operated sufficiently long to reach the set pressure of 250 lb. the discharge controller of the second unit is reset to 500 lb. and the same procedure is followed in starting the second unit. When the controller has completed its function, the third unit is started in same way.

There will be sequence shutdown of units if pump case pressure reaches 1,000 lb. or if mainline pressure exceeds 825 lb.; units Nos. 1, 2 and 3 are shut down in that order. If suction drops too low, units are shut down in reverse order.

Certain construction features of 20-in. line stations should be mentioned. Pumps and motor rooms are separated by a firewall with a continuous glass sash at eye level. Shafts penetrating the wall rotate in stuffing boxes.

Choice of materials for building construction has been limited by war conditions. Wood framing is covered with ⅝-in. fibre board; inside the building it is covered with ⅛-in. Transite, outside with ¼-in. Transite. Roofs have asbestos shingles. Doors are of wood. No reinforcing bars could be procured for concrete foundations. Buildings for stations of the WEP 24-in. crude-oil extension line are of the same type.

BOOK REVIEW

OUT OF THE SAND. By George Lindstrom. Published by High Twelve Publishing Co., 1104 Prospect Ave., Cleveland, Ohio. 264 pp. $2.50.

This is a historical novel based on the discovery of oil, both the story and the locale being based on history. Into the story have been woven incidents involving Abraham Lincoln, Booth, Drake, John D. Rockefeller, P. C. Boyle, and others contemporaneous with early oil development.

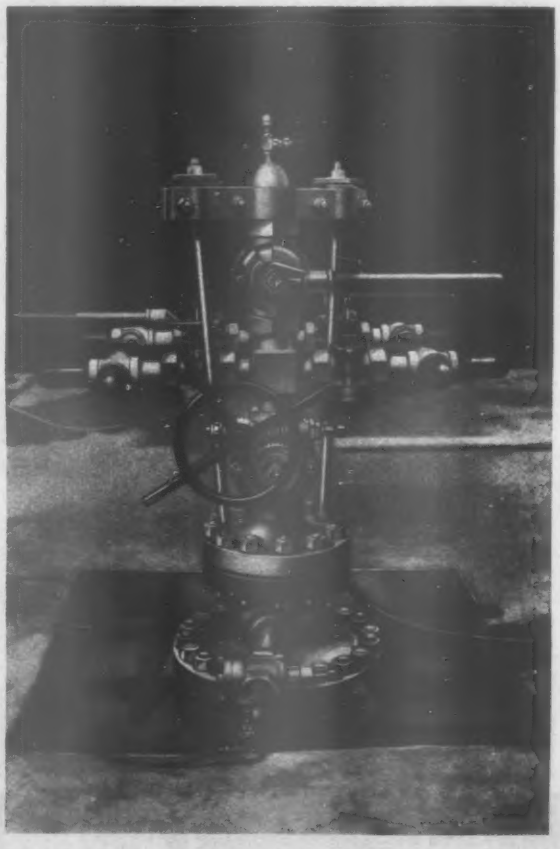
ON ACTIVE SERVICE

Newman-Milliken glandless lubricated plug valves are playing their part in the war effort. They are giving vital service on pipe lines controlling high-pressure oil and ensuring efficient production of this essential munition of war. This illustration shows one of the many oil well Christmas Trees in Trinidad equipped with Newman-Milliken Valves. Pressures handled are up to 5,000 lbs. per square inch (Valves are tested to 10,000 lbs.) and sizes ½" to 12" can be supplied with screwed or flanged ends, rectangular or round port, and wrench or gear operated.

★ This sectioned illustration is of a Full Round Port Gear-operated Newman-Milliken and shows the unique parallel plug which cannot stick or jam. The lubricant ducts, by which the valve is lubricated, can also be seen.

Newman, Hender & Co. Ltd

WOODCHESTER GLOS. ENGLAND



Practices Employed in Reconditioning Phillips' Gasoline Pipe Line

by L. A. Hugo and G. P. Jennings†*

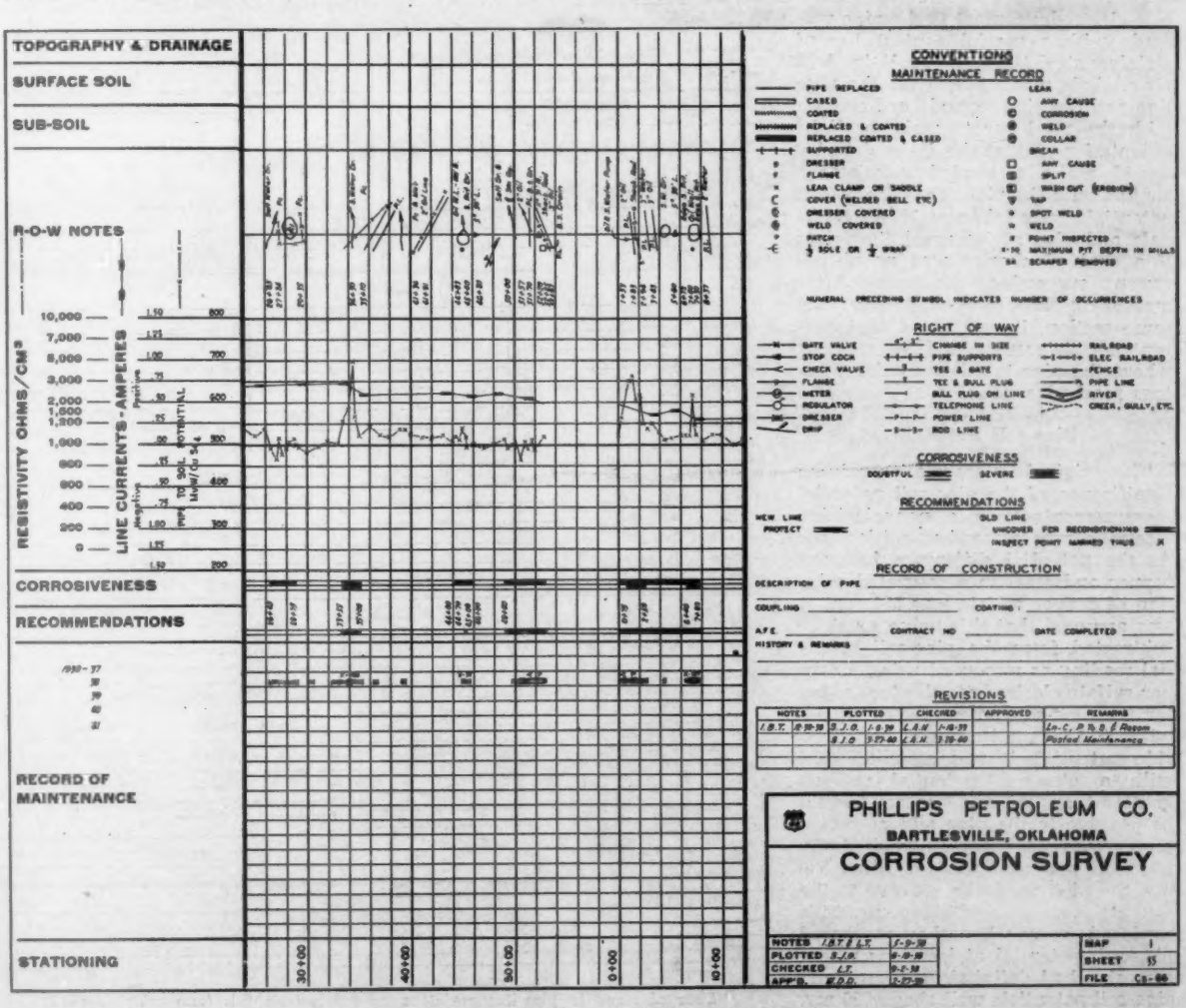
THE operation of one of the oldest, as well as one of the largest, product pipe-line systems in the country requires that an adequate, effective program of maintenance and reconditioning be actively followed.

While the ever-present problem of internal corrosion is usually more serious in product lines, the necessity of combating external corrosion applies to practically all pipe lines regardless of product handled and should, therefore, be of more or less general interest. It is the purpose of this article to present a procedure for determination of the locations along the line where added protection against exterior corrosion is required before actual leaks develop, and further to present reconditioning methods which have been followed with satisfactory results. No attempt is made to evaluate the relative merits of different methods of reconditioning.

The original segment of Phillips' present product pipe-line system, 681 miles between Borger, Tex., and East St. Louis, Ill., was constructed in 1931. After 7 years' operation the occurrence of periodic leaks indicated that definite steps should be taken to eliminate such leaks and a continuing program of reconditioning and corrosion prevention should be instituted.

The first step was to locate the "hot spots" by means of a corrosion survey which was conducted by the engineering department. A few companies had been reporting great suc-

*Engineer and †chief engineer, gasoline pipe-line department, Phillips Petroleum Co.



Type of report used in conducting corrosion survey

cess with line currents prior to 1938. It was during this year that it was decided to try this method in an effort to locate the sections of pipe that were severely corroded. The investigation was started on the section from Wichita to Paola, Kans., which was known to be the most generally corrosive section.

It was soon discovered that on certain days the magnitude of the line current fluctuated rapidly, and measurements on these days using only one meter were very unreliable. The cause of such current variations was attributed to magnetic storms or changes in the earth's potential at widely separated points along the pipe line as there was no source of stray currents in the vicinity.

As an experiment, it was decided to measure pipe-to-soil potential on one of the days when the line current variations were too severe for current measurements; the soil potentials seemed to be independent of the current variations. The instrument used for these measurements was a Rhodes potentiometer voltmeter. Contact to the soil was made with a copper sulfate electrode; contact to the pipe was made with a special contact bar of stainless steel fitted with a ¼-in. drill bit. A hole was made above the pipe line and the pipe tapped hard enough with the prod bar to make a slight indentation so that the ¼-in. drill bit would make a good low-resistance contact with the pipe. The pipe-to-soil potentials were taken at 100-ft. intervals and also at intermediate points if a decided change was noted between successive readings. After measuring line currents over the same section, it was noted that current losses were found in sections where the pipe-to-soil potential readings reached a peak.

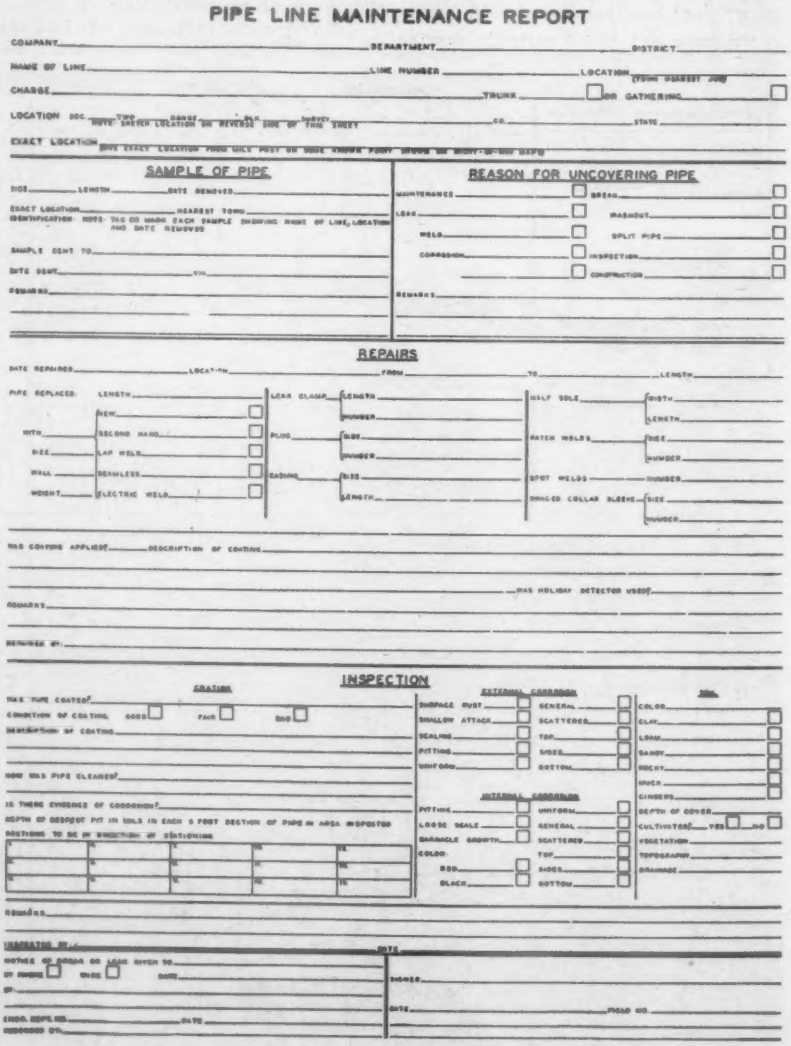
Pipe-soil Potential

The original interpretation of the significance of the pipe-soil potential measurements with a nonpolarizing electrode was somewhat misleading. As the potential difference between copper and steel in a saturated solution of copper sulfate was 550 mv., it was assumed that this value must be subtracted from the pipe-soil potential reading as measured using a copper sulfate electrode to the true value for the pipe-soil potential. Therefore, without the application of any outside potential, it was assumed that with a pipe-soil potential reading greater than 550 mv. the soil would be positive to the pipe and no corrosion would be expected; and if the pipe-soil potential was less than 550 mv. the pipe would be positive to the soil and corrosion would occur. This confused many when they measured pipe-soil potential at locations where corrosion had definitely occurred and pipe-soil potentials well above 550 mv. were observed.

The potential between the pipe and a copper sulfate electrode with no current flow will vary with different type soils because of the liquid junction potential. Therefore, it is obvious that no definite value of pipe-to-soil potential can be set to determine that point at which corrosion will occur. However, by measuring pipe-to-soil potential at regular intervals along a pipe under the same conditions, it has been found that at points where corrosion is definitely occurring there will be a decided increase or peak in pipe-to-soil potential values as read with a copper sulfate electrode. Pipe-to-soil potentials plotted graphically along the stationing of the pipe line will almost always show a peak in the pipe-to-soil potentials where corrosion is most severe; however, a severely corrosive condition is not always found at all such peaks in the pipe-to-soil potentials. Corrosion is generally accepted as being electrochemical in nature. Any corrosion that takes place is accompanied by electrical currents. Whether the currents are the cause or the result of corrosion is a debatable question; but for the present purpose it is sufficient to know that one cannot exist without the other. Where currents discharge there is corrosion, hence if we can locate the discharge points we have found the corrosion.

Current Readings

To locate a discharge point by means of current readings requires at least two readings, one on each side of the anodic area. The difference between readings, to indicate hot spots, is generally not more than 0.2 of a millivolt and is seldom over 1 mv. by using the potential drop method. Obviously it is impossible to take reliable readings with only one instrument while currents fluctuate because during the time the instrument is


PIPE LINE MAINTENANCE REPORT

COMPANY _____ DEPARTMENT _____ DISTRICT _____

NAME OF LINE _____ LINE NUMBER _____ LOCATION _____ (FROM NEAREST JOG)

CHARGE _____ TRUNK ☐ OR GATHERING ☐

LOCATION SEC. _____ TWP. _____ RANGE _____ BLK. _____ SURVEY _____ CO. _____ STATE _____
(GIVE SKETCH LOCATION ON REVERSE SIDE OF THIS SHEET)

EXACT LOCATION _____
(GIVE EXACT LOCATION FROM MILE POST OR SOME KNOWN POINT SHOWN ON RIGHT-OF-WAY MAPS)

SAMPLE OF PIPE

SIZE _____ LENGTH _____ DATE REMOVED _____

EXACT LOCATION _____ NEAREST TOWN _____

IDENTIFICATION: NOTE: TAG OR MARK EACH SAMPLE SHOWING NAME OF LINE, LOCATION AND DATE REMOVED

SAMPLE SENT TO _____

DATE SENT _____ VIA _____

REMARKS _____

REASON FOR UNCOVERING PIPE

MAINTENANCE ☐ BREAK ☐

LEAK ☐ BLOWOUT ☐

WELD ☐ SPLIT PIPE ☐

CORROSION ☐ INSPECTION ☐

☐ CONSTRUCTION _____

REMARKS _____

REPAIRS

DATE REPAIRED _____ LOCATION _____ FROM _____ TO _____ LENGTH _____

PIPE REPLACED: LENGTH _____ WITH _____ SIZE _____ WALL _____ WEIGHT _____

NEW ☐ SECOND HAND ☐ LAP WELD ☐ SEAMLESS ☐ ELECTRIC WELD ☐

LEAK CLAMP ☐ LENGTH _____ NUMBER _____

PLUG ☐ SIZE _____ NUMBER _____

CASING ☐ SIZE _____ LENGTH _____

HALF SOLE ☐ WIDTH _____ LENGTH _____

PATCH WELDS ☐ SIZE _____ NUMBER _____

SPOT WELDS ☐ NUMBER _____

SWAGED COLLAR SLEEVE ☐ SIZE _____ NUMBER _____

THIS COATING APPLIED? _____ DESCRIPTION OF COATING _____

REMARKS _____ WAS HOLIDAY DETECTOR USED? _____

REPAIRED BY: _____

INSPECTION

COATING

THIS TYPE COATED? _____

CONDITION OF COATING: GOOD ☐ FAIR ☐ BAD ☐

DESCRIPTION OF COATING _____

HOW SOIL PIPE CLEANED? _____

IS THERE EVIDENCE OF CORROSION? _____

DEPTH OF DEEPEST PIT IN SOLID IN EACH 5 FOOT SECTION OF PIPE IN AREA INSPECTED

SECTIONS TO BE IN DIRECTION OF STATIONING

1.	6.	11.	16.	21.
2.	7.	12.	17.	22.
3.	8.	13.	18.	23.
4.	9.	14.	19.	24.
5.	10.	15.	20.	25.

EXTERNAL CORROSION

SURFACE RUST ☐ GENERAL ☐

SHALLOW ATTACK ☐ SCATTERED ☐

SCALING ☐ TOP ☐

PITTING ☐ SIDES ☐

UNIFORM ☐ BOTTOM ☐

INTERNAL CORROSION

PITTING ☐ UNIFORM ☐

LOOSE SCALE ☐ GENERAL ☐

BARNACLE GROWTH ☐ SCATTERED ☐

COLOR: TOP ☐

RED ☐ SIDES ☐

BLACK ☐ BOTTOM ☐

SOIL

COLOR _____

CLAY ☐

LOAM ☐

SANDY ☐

ROCKY ☐

MUCK ☐

CINDERS ☐

DEPTH OF COVER _____

CULTIVATED? YES ☐ NO ☐

VEGETATION _____

TOPOGRAPHY _____

DRAINAGE _____

REMARKS _____

INSPECTED BY: _____ DATE _____

NOTICE OF DEFECTS OR LEAK GIVEN TO _____

BY PHONE ☐ WIRE ☐ DATE _____

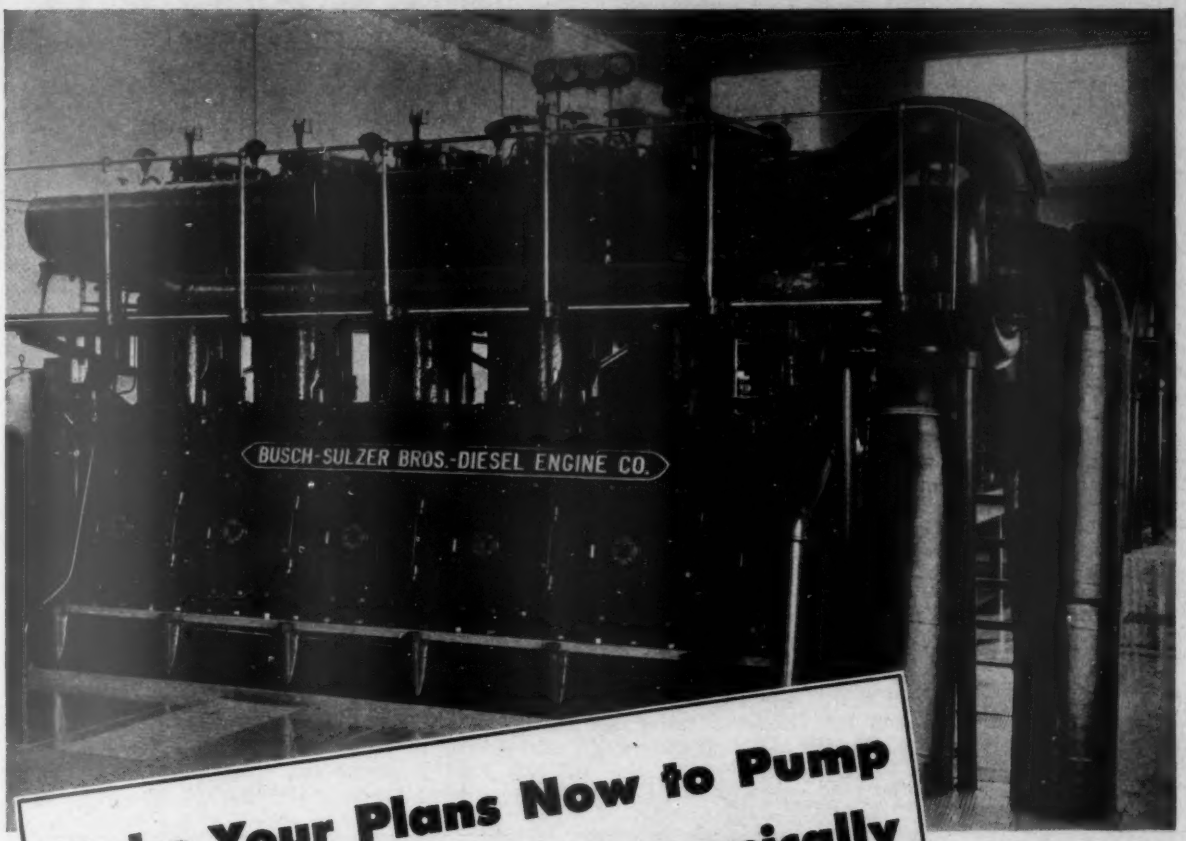
BY _____

SIGNED _____

ENGR. DEPT. NO. _____ DATE _____ DATE _____ FIELD NO. _____

RECORDED ON _____

Data obtained in pipe-line maintenance are put on this form which serves to guide future operations of the gasoline pipe line of Phillips Petroleum Co.



Make Your Plans Now to Pump Bigger Loads More Economically

Busch-Sulzer 500 h. p. engine for the Stanolind Pipe Line Company, originally installed in 1924 and supercharged in 1940 to obtain increased horsepower.

If the trend in postwar pipelines is to be toward bigger diameters, power for pumping certainly will be stepped up. To step up the dependability and economy of that power, plan now to use Busch-Sulzer Diesels. They have been tried and proved in the pipeline field. There are more than 200 Busch-Sulzer Diesels in pipeline service today—not a few of them with twenty-five and more years of reliable service to their credit.

In making your plans, you can choose from a variety of horsepower ratings—from 450 to 3400. No matter which type of Busch-Sulzer Diesel you select, you will be impressed with the simplicity of its design—a feature that shows up again in low operating and maintenance costs. Busch-Sulzer was the first to perfect and introduce the trunk piston principle into the larger Diesels. The innovation was greeted with skepticism, but a dozen years of exceptional performance has proved the soundness of this improvement.

Although we are working 'round the clock on naval ordnance, we are able to fill orders for high priority. Your inquiry will receive prompt attention.

BUSCH-SULZER BROS. DIESEL ENGINE COMPANY
SAINT LOUIS

BUSCH-SULZER ST. LOUIS.

AMERICA'S OLDEST BUILDER OF DIESEL ENGINES

Pipe Line Companies Now Using Busch-Sulzer Diesel Engines:

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TEXAS EMPIRE PIPE LINE CO.
TEXAS NEW MEXICO PIPE LINE CO.
TIDEWATER PIPE CO.

being moved from one point to the next, the current may have changed and the interval between the points of contact be indicated either to be collecting or discharging, depending on whether or not the current has increased or decreased during the move. Therefore, all current measurements to locate discharge areas are made using two meters and readings taken simultaneously.

The pipe-to-soil potential and line-current readings, obtained as described previously, are plotted on a standard corrosion map along with other information which might affect the corrosiveness of the soil. There is also a place on the map where a record of all maintenance work is recorded for each year. The recommendations of the corrosion-survey engineer are also shown on this map in order that copies of it may be sent to the maintenance crews in the field. A close record of the maintenance work performed shows that the corrosion survey has been successful in locating many corrosive areas that would not have been located otherwise.

The maintenance crew then uncovers the line at points recommended for inspection by the corrosion survey engineer. The pipe is then cleaned by using a power-driven cleaning machine which employs a cutter head followed by a wire brush head. The cutter head removes the bulk of the dirt and scale and the brushes following complete the job so that very little hand work is necessary. Pitting hammers are used to remove the scale from the pits. The depth of the deepest pits in each 5-ft. section of pipe inspected are measured in order to determine the severity of the corrosion, and correlate the actual findings in the field with those indicated by the corrosion survey. While the corrosion survey may indicate corrosion between two definite points of say 200 ft. apart, if corrosion exists beyond this area, the inspection is carried on until good pipe is reached.

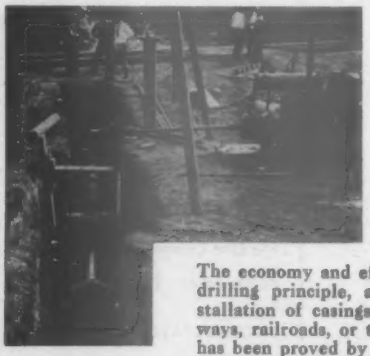
Repairing Pipe

If pits are not too numerous or too deep, they are spot-welded using ⅛-in. or 5/32-in. electric welding rod. If the pits are too deep to safely spot weld or too numerous to economically spot weld, they are covered by 8⅝-in. i.d. by ¼-in. thick preformed unbeveled half soles. If the condition is still too bad to permit half soling, the bad section is cased with 9½-in. i.d. by ¼-in. thick preformed split casing beveled on all four sides. Half soles or casing are allowed to rust before using to assist in the removal of the mill scale. The mill scale is then removed using power sanders before applying to the line. All welding is carried on while the line is operating and under regular pressure except when an extremely bad section is encountered; in this case pressure is lowered but the flow is, of course, continued.

After all actual repairs are completed, the pipe, half soles and casing are given a final cleaning preparatory to painting. Coal-tar primer is then applied followed by two $\frac{1}{16}$-in. thick coats of coal-tar enamel and then a spiral asbestos wrap. In locations where the line is continually under water, a flood coat of coal-tar enamel is applied over the spiral asbestos wrap to protect the wrap. Unless no corrosion is evident, all points inspected are coated and wrapped before covering the line. After coating, a holiday detector is used to check the work. By getting a good job of coating it is hoped that these locations will not have to be reconditioned again, at least for a number of years.

The above-outlined method of reconditioning is expensive but it must be remembered that it permits nearly 100 per cent operation of the line and that the areas of attack constitute only a very small percentage of the total length of the entire line. Thus by coordination of effort between the corrosion survey crews and

(Continued on page 176)



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Trends of Future Pumps Are Indicated by Recent Designs

*by Lloyd T. Gibbs**

THOSE men in the oil industry responsible for the selection of pumps have long been aware of the limitation of selection for given applications. This was outlined in a forward-looking article by W. G. Heltzel in The Oil and Gas Journal, September 18, 1941. This article also brought out the fact that some equipment has been in operation 20 or more years, and probably will be used another 20 or more. This is mentioned as a sign that the oil industry is growing up and the use of equipment for 20 years or more places a different light on the initial investment. If additional investment in equipment gives better operation and greater efficiency, this improvement being either mechanical or over-all efficiency in total operations, then the additional investment is clearly justified.

The White Eagle Pipe Line Division of Socony-Vacuum Oil Co., Inc., installed a very unusual station on its gasoline line some time ago which merits discussion. This station was placed in operation about November 1941, and consists of two vertical triplex single-acting variable-stroke pumps using electric motors as prime movers; they are automatically controlled.

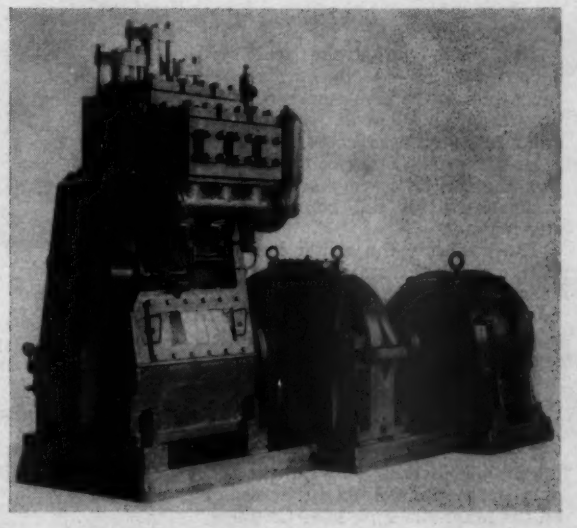
They are 6-in. stroke pumps, having a maximum capacity of 4,750 bbl. per day at 1,000 lb. working pressure. The speed of these pumps is 225 r.p.m. of the crankshaft, which means 675 pumping strokes per minute.

The station is electric driven; 100-hp., three-phase, 2,200-volt motors are used. The main-line suction and discharge pressures, at the station, control the capacity of the pumps. The speed is always constant. Two recording-pressure controllers are used and each is set for the pressure desired. The discharge pressure is normally set at 1,000 lb. and the suction pressure at approximately 50 lb. If the discharge pressure tends to rise, due to any manipulations of the line or stations on the system, the pressure regulator will short stroke the pumps, causing them to have a smaller throughput.

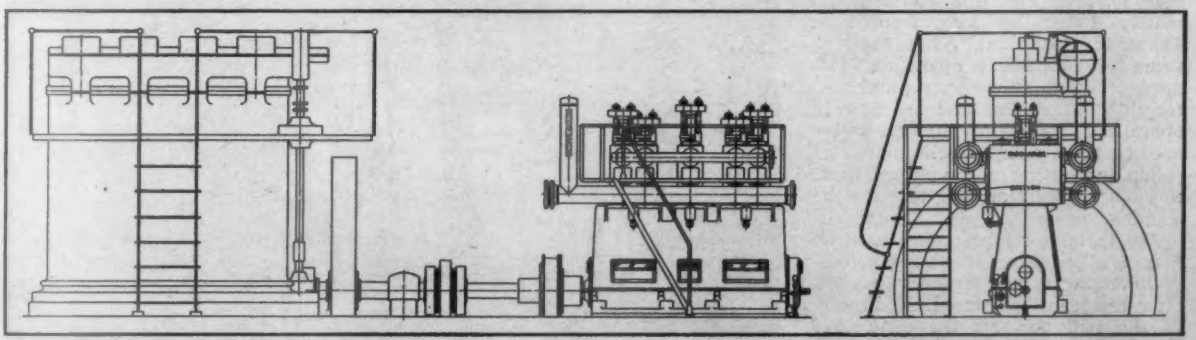
Conversely, if the discharge pressure falls, the pressure controller will tend to increase the length of stroke, thus giving a higher throughput. If the suction pressure increases, the reverse is true and the pump will tend to increase its stroke and throughput in order to draw down the suction pressure. If the suction pressure tends to fall, the reverse of the above action takes place. The pump is, therefore, under full automatic control at all times for any condition of pipeline pressures or capacities within the designed limits, and this is all done by the use of two pressure controllers. This installation is so arranged that if the instrument air pressure fails, the pumps will go to zero stroke.

The feature of this equipment is the high mechanical efficiency of a plunger pump with all the variable characteristics of the centrifugal pump. Recently a third variable stroke pump was ordered for this station and will be in operation by the time this article appears.

The station immediately preceding this station contained motor-driven centrifugal pumps. The writer checked the actual power consumption at both



View of new design of constant-stroke pump



Large-capacity quintuplex plunger pump with floating shaft direct connected to engine—no gears

*Engineer, Aldrich Pump Co.

stations during a given period. The station containing the variable stroke pumps was handling 9,200 bbl. per day at 1,100 lb. discharge and 265 lb. suction pressure, while the preceding station was handling the same quantity at 1,200 lb. discharge pressure and 175 lb. suction pressure. Reducing these figures to the amount of work done for equal differential pressures showed that the variable-stroke plunger pump station would use 119 kw. while the preceding centrifugal pump station was consuming 174 kw.; or a total difference of 55 kw. The variable-stroke plunger pumps were, therefore, putting out 6.5 lb. per horsepower input, while the centrifugal pumps were putting out 4.5 lb. per horsepower input; or the variable-stroke pumps were performing 45 per cent more useful work.

If this 55 kw. saving is evaluated at 1 cent per kw.-hr., the saving amounts to $4,800 per year, or a sum of $48,000 in a 10-year period. It is customary to figure the costs of producing horsepower by using gas or diesel engines at about half the purchased power rate so that if engines were used in the actual case outlined above, the savings would amount to $2,400 per year or $24,000 in a 10-year period.

Change in Stroke

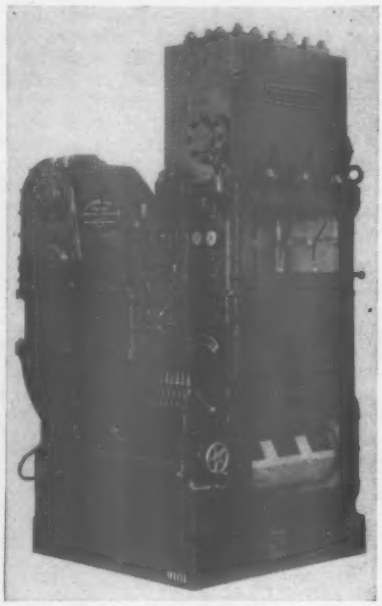
The change in stroke which responds to a change in line pressure takes place within a few seconds. It only requires about 20 seconds to go from full stroke to no stroke, which is full capacity to no capacity, so that the control is very sensitive and accurate and is not complicated in any manner.

The last time the writer had occasion to check this station, it was being operated by one man who was relieved once a week by the line walker in that district. This is pointed out to show the possibilities that the operating management of pipe-ile companies now have to save operating expense in either power cost or labor, or both.

Another installation of these variable-stroke plunger pumps was made on the Magnolia Pipe Line Co. butane line in Texas in 1940, and was discussed in The Oil and Gas Journal, May 30, 1940. This line was approximately 186 miles long from East Texas to Beaumont. After about 2 years of continuous operation, two more of these pumps were purchased for this butane line and are now in operation. Porcelain plungers were used on these pumps to eliminate corrosion and pitting on the plungers and to reduce the wear and tear on the packing.

The variable-stroke pumps used by Magnolia handling butane can actually function as charge pumps, as the pipe line can be connected directly to the still and all the control of flow is in the hands of the still operator at Beaumont, Tex., even though some of these pumps are 186 miles away.

Stanolind Pipe Line Co. the latter part of this year will install an 800-hp. vertical inverted quintuplex pump at Lakenon, Tex. This particular unit will run at 155 r.p.m. of the crankshaft, or higher. It will be directly connected to a diesel engine by means of a floating shaft, and no reduction gears will be used between the engine and pump. The elimination of the customary gears will save at least 2 per cent in power and, if this is evaluated on this large horsepower over a period of years, the savings run into thousands of dollars.



View of variable-capacity pump used on White Eagle gasoline Line

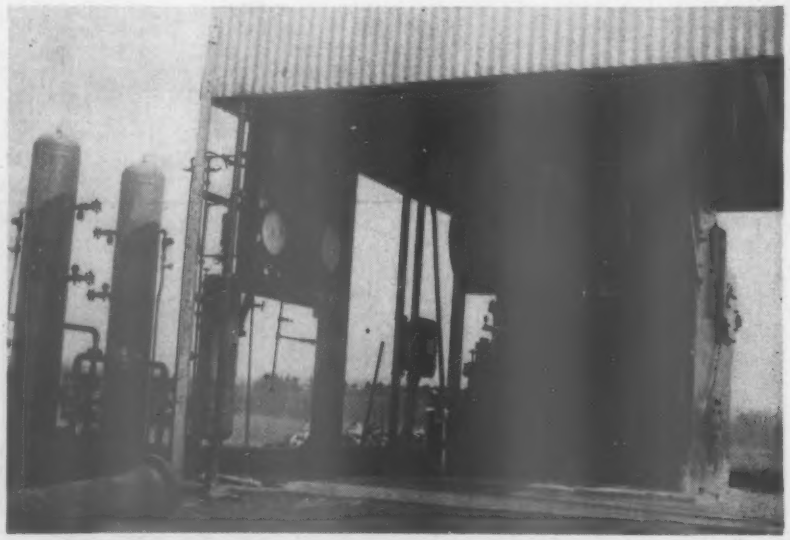
A vertical inverted multicylinder pump, together with a variable-stroke pump, can be used together in any pump station so that the total variable capacity of the station can be either 33⅓ per cent, 50 per cent, or any other percentage deemed necessary, according to the number of units of each type used in the station.

The writer started on the application of pumps about 1928 when the first change in pump design was taking place in pipe-line and refinery pumps. The first long gasoline line designed and laid in America was conceived at about this time, and it was the writer's privilege to sit in on the design of this line. A closed system was obvious in order to hold evaporation losses and leakage to a minimum. It was very quickly discovered that there was only one type of equipment available; and that was the centrifugal pump, if we adhered to the closed system.

Pump designers had reached a stage of inertia as compared to other types of machinery used in the oil industry. The writer remembers that in those days we had to listen to representatives of pump manufacturers tell us why centrifugal pumps would not run 3,600 r.p.m. At the same time, the writer had just finished successful tests on a bottom hole, electrically driven centrifugal pump used in an oil well at speeds up to 10,000 r.p.m., using at least 10 stages; and it was discouraging to note the closed attitude of the pump-manufacturing industry in general at that time. Recent signs indicate that pump designers are finally realizing their opportunities.

Centrifugal pumps have certain handicaps as well as advantages. Some of the handicaps are:

1. Low efficiency.
2. Rapid wear of parts.
3. Highest efficiency at only one



View of field installation of variable-capacity pump

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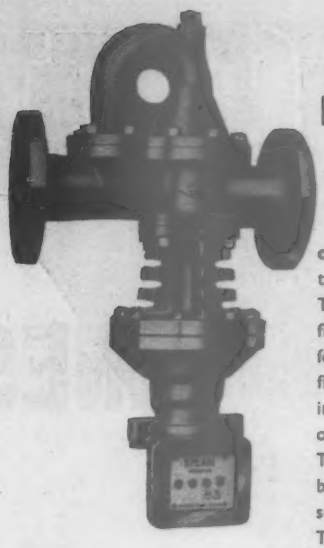

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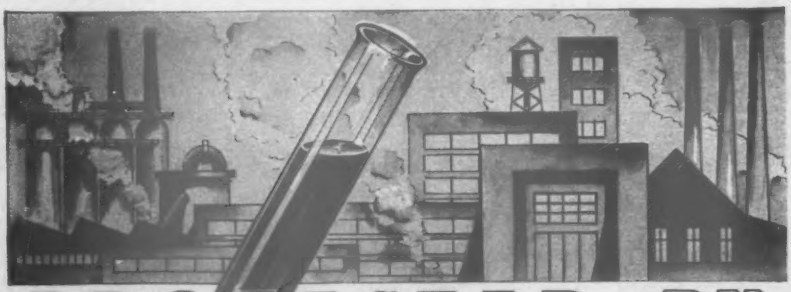

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point, or a restricted range of capacity.

4. Leakage problems.

5. Wear of pump parts caused by the sudden change of velocity head in the pump with certain fluids; and inherent vibrations present with slender high-speed shaft design.

The above disadvantages are fundamental to the design of a centrifugal pump. The rapid wear of parts, and the leakage problem, are due to the close fits necessary between impellers and wearing rings associated with vibration of rotating parts and the small diameter of shaft that has to be packed for high-speed operation.

Centrifugal pumps have their correct uses and a very great majority of the pumps used are centrifugal. The writer only wishes to point out here that there is now available equipment that was not available a few years ago and, therefore, the flexibility of design of pumping equipment is greatly enlarged.

The pumps shown in the accompanying photographs are designed similar to diesel and gas engines and, from a mechanical viewpoint, their speed range is the speed range of equivalent engines; and the only limiting feature to the speed of this type of pump is the quantity of fluid that can be handled by the fluid end. Considerable research work has been done to secure the correct fluid end and valve design for these improved pumps—all of which results in a greater selection of pumping equipment by the oil industry than they have ever had before.

To sum up the features of interest to operators, a partial list follows:

1. Vertical design saves space and employs the same features of modern diesel-engine design, including pressure lubrication.

2. The speeds mentioned herein approach engine speeds which eliminate gears, or reduce the gear ratio; and also lessen the effect of pulsating pressure conditions.

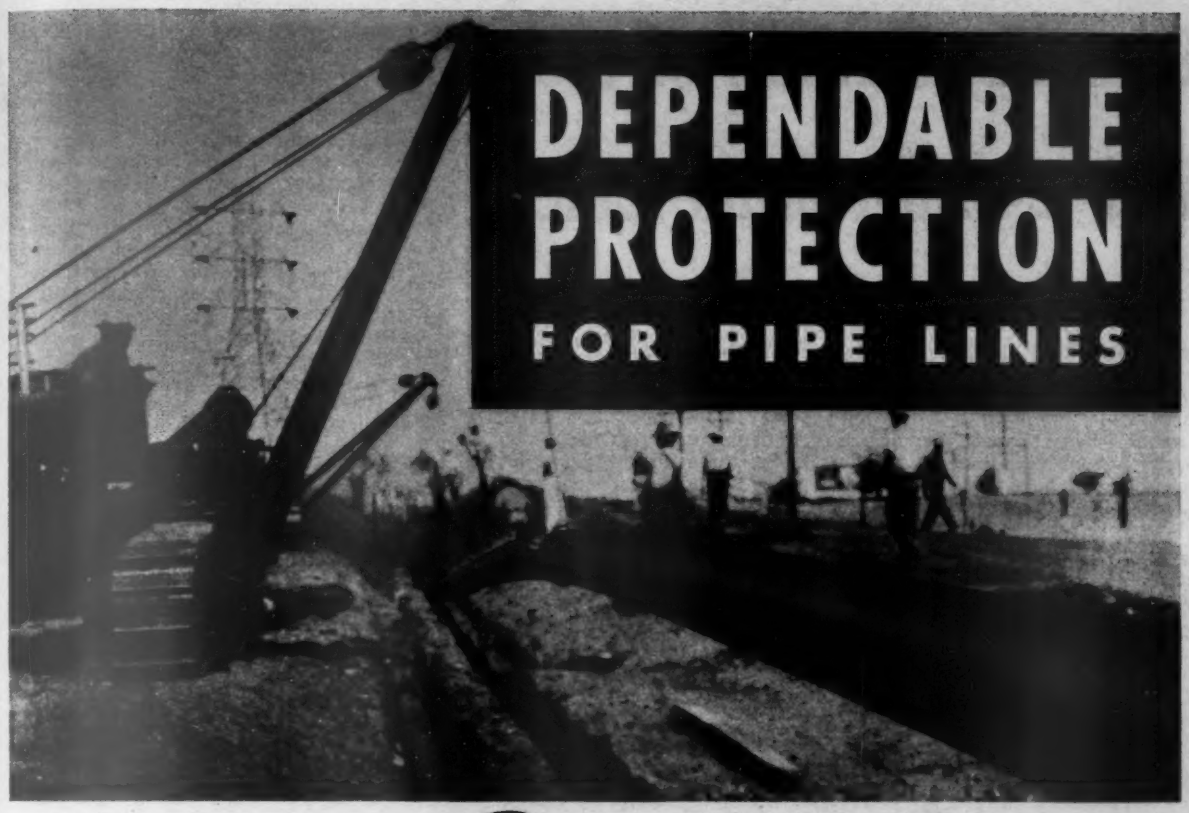
3. The proper use of the variable-stroke pumps makes possible a fully automatic station, thereby definitely reducing the operating pay roll.

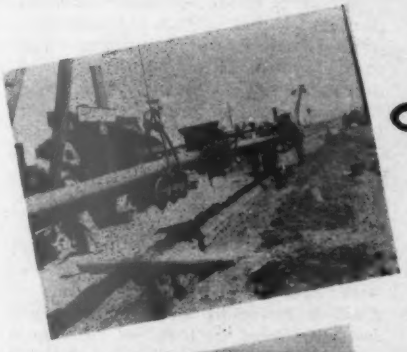
Reconditioning Phillips' Gasoline Pipe Line

(Continued from page 170)

pipe-line maintenance crews, it has been possible to not only reduce to a minimum the number of leaks, but also to direct the efforts of the maintenance crews to the location along the line where their efforts will produce the maximum benefit.

Its effectiveness is evidenced by the fact that corrosion leaks are now on the decline and most of those that do occur are at locations recommended for inspection but that have not as yet been reconditioned.





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Pumping Stations of the WEP 24-Inch Crude Line

by Paul Reed

EXPERIENCE in operation has demonstrated that the pump stations of War Emergency Pipelines, Inc.'s 24-in. crude-oil line not only have the largest-capacity equipment for petroleum pipe-line service but that they also have the highest overall efficiency of any in the world. For more than a week at the end of last month a throughput of 308,000 bbl. daily was maintained. Shortly before that 327,970 bbl. were delivered in 24 hours at Norris City, Ill.

Since the three 16 by 12-in. single-stage centrifugal pumps at standard stations of the line can run at high capacity with speeds of 1,750 to 1,785 r.p.m., which are low for pipe-line service, it is possible to operate with minimum suction pressure down to 20 or 30 lb. In an emergency, suction pressure can even be still lower. Each pump is rated at 8,750 g.p.m. or 300,000 bbl. daily against 630-ft. head or 229 lb. per sq. in.

Casings of the pumps are made with very heavy ribbing in order to effectively utilize high-test cast iron necessary for their construction, due to the wartime shortage of steel. Hydraulic design of this type of pump casing was handled so as to avoid radial unbalance at high heads and to attain the highest possible efficiency.

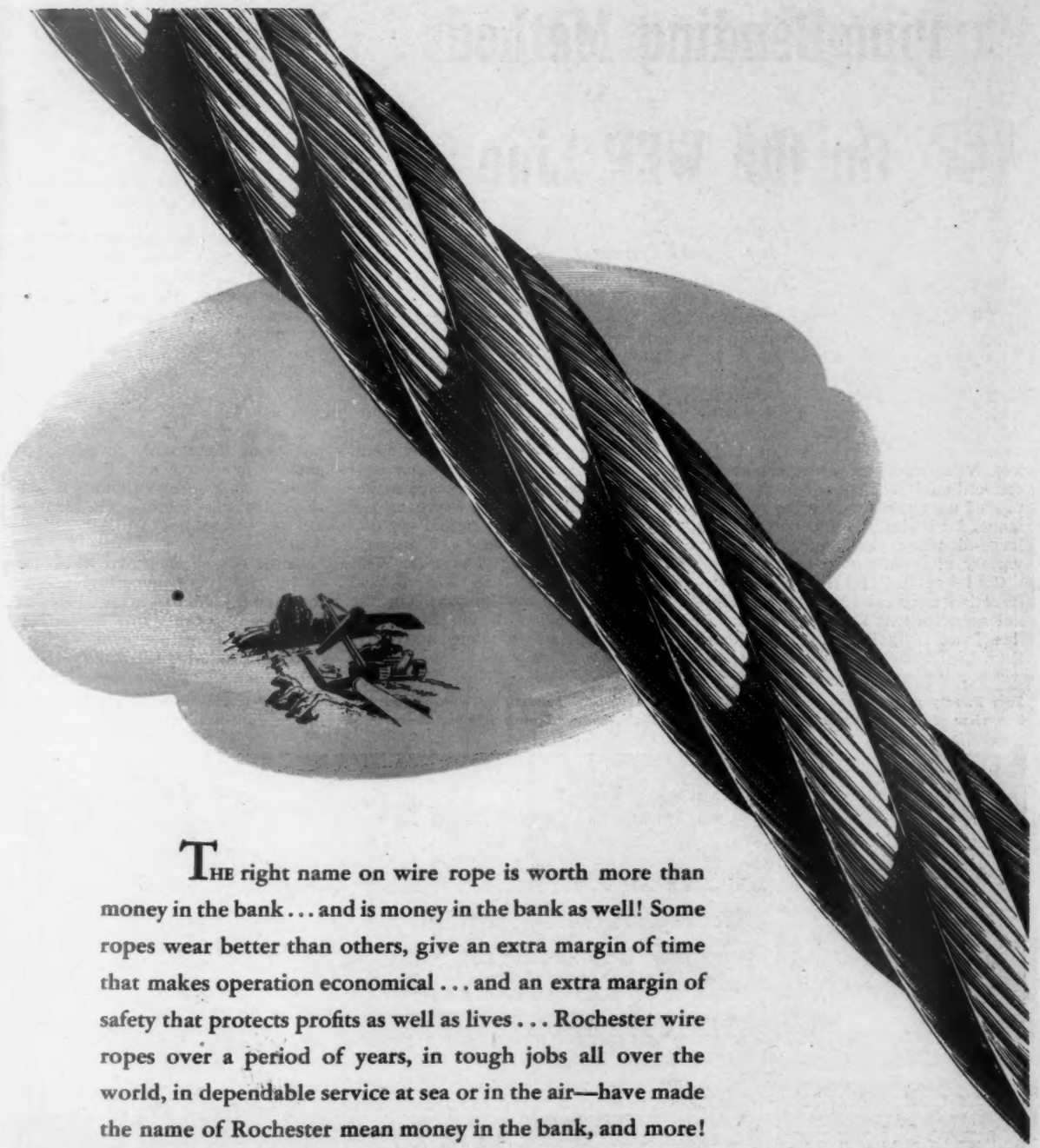
Piping provides for straight flow between pumps. All valves are hand operated. The urgent need for completing the project rapidly permitted the installation of only limited automatic controls.

Each station is protected by mercoid equipment which functions as follows: (a) The third pumping unit is cut off when discharge pressure reaches 800-lb. line pressure; (b) the second unit is cut off at 675-lb. line pressure; (c) when suction pressure drops to minimum (20 or 30 lb.) the leading unit is cut off first and soon after the others are cut off in succession; (d) a horn sounds when suction pressure is low (25 or 35 lb.).

The large motors driving the main-line centrifugal pumps are controlled individually by push buttons from several points throughout the building and even from the pump room itself. These motors are 1,500-hp., 1,800 r.p.m., 2,300-volt squirrel cage of a standard induction type which drive the pumps by an 18-in. shaft through a fire wall.

(Continued on page 182)

Left: Motor room with switchboard and three 1,500-hp. electric motors, each of which is cooled by means of a special duct with forced draft. Below: Pump room with 16-in. by 12-in. single-stage centrifugal pumps operating at 1,780 r.p.m.



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Pipe-Bending Methods On the WEP Line

by Paul Reed

THE principal innovation developed in the course of construction of War Emergency Pipelines, Inc.'s 24-in. and 20-in. lines from Texas to the East Coast has been a bending jig which is now being extensively used in laying the 20-in. products line. On the whole it may be said that the big WEP lines have been laid by conventional methods which have proved adequate for meeting requirements for laying the unusually heavy large-diameter pipe under the great variety of conditions encountered.

Cold bending and firing-line construction were called for in the original specifications for the 24-in. crude line from Longview, Tex., to Norris City, Ill. But as soon as the line started, provision was made for stovepipe construction which required hot bending. While the line was being built to Norris City, about half of the spreads were using the stovepipe and hot-bending methods. In the construction of the 24-in. extension to the East Coast and in the laying of the 20-in. line there has been considerable use of firing-line construction with cold bending. However, the organization which originally demonstrated what could be done with the stovepipe laying of pipe for WEP has continued to use this method successfully on all its jobs. On the eastern extension of the 24-in. line certain contractors made much use of factory bends.

The latest development in pipe-bending methods has been the introduction of a machine, known as the pipe-bending jig invented by J. D. (Jim) Cummings of Crutcher-Rolfs-Cummings, and improved by him as a result of a number of experiments and tests in the field.

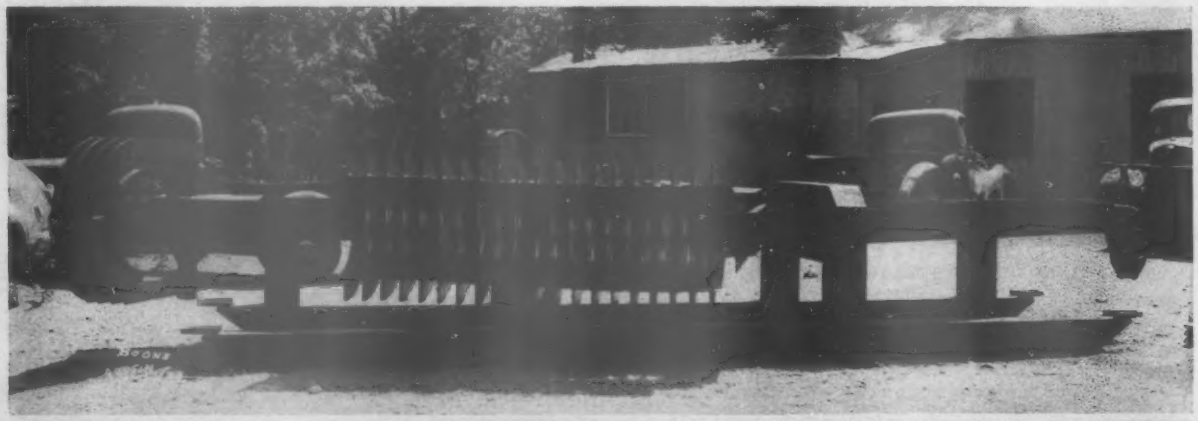
The hot-bending method has been the customary one used extensively, particularly for bending large-diameter gas lines. In this method, heat is applied by burning kerosene in a space between a portable shield with a curved surface and the part of the pipe to be bent. The shield is fastened to an A-frame which lies on the ground. As the pipe is heated, the end is pulled by a winch line to the opposite leg of the A-frame.

Use Three Tractors

A good deal of the cold bending has been done with three tractors, one of which bends the pipe by means of a conventional bending shoe. By this method the pipe lies flat on the ground while bending is done.

In the construction of a 16-in. feeder line for the crude-oil system and the laying of the 20-in. products line, Williams Brothers Corp. has successfully bent pipe by use of a pivoted bending shoe which is installed at the

Top: Twenty pivoted shoes mounted on skid frame of CRC bending jig with hinged yoke at left and snatch block at right. Left, below: Top view of jig, at Sharman & Allen WEP job. Right, below: Spring holding shoes in straight-line position



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base of the A-shaped boom of a boom tractor. Until recently it had been generally believed that this method would only be practicable for bending pipe up to 12 in. in diameter.

Following up the successful operation of Natural Gas Pipeline Co of America in the laying of 26-in. pipe in 1940, arrangements were made to have factory bends furnished to the contractors for the construction of the 24-in. extension from Norris City to the East Coast. The Bechtel-Dempsey organization which had used these prefabricated bends satisfactorily on the Chicago gas line continued to install them on a large scale during the construction of the extension. However, most of the contractors preferred to follow conventional methods. When plans were being made for the laying of the 20-in. products line no factory bends were provided.

At present every spread laying pipe for the 20-in. products line is furnished a C.R.C. bending jig by WEP. The incentive for adopting such a device was that the management of WEP had data which indicated that

Shoe for cold bending of 24-in. pipe by spreads using firing-line method

large savings could be made with an efficient bending machine which would reduce the amount of tractor equipment required, reduce the chance for injurious buckling of pipe and which would also make it possible to cold-bend pipe near the end of a joint. It can be observed from the illustrations that this bending jig consists essentially of a series of 20 hinged shoes held in line by a heavy spring. These hinged shoes and a pivoted yoke device for holding the pipe are mounted on a substantial frame which can be dragged over the ground on skids. When bending is done, a joint is held rigidly by the yoke; the end of it is pulled by a wire line attached to a sling of thick belting. This wire line passes through a snatch block at an opposite end of the frame from the yoke device. It is claimed that experience in the field shows that with this type of bending jig a bend can be made as near as 4 ft. from the end of the joint. It is also said that experience shows that this method makes cold bending practicable with the use of only one tractor, thus eliminating two of the three tractors frequently used in bending large-diameter pipe for WEP.

The bending jig is said to have its greatest advantage in situations where it displaces hot bending. Some contractors on the WEP 20-in. line claim that with the jig, bends can be made in 3 minutes instead of the 15 to 30 minutes frequently required for hot bending.

As far as is known, this bending jig is a radical departure from previous methods. It is reported that because of its unusual nature there was some difficulty in persuading government authorities as to its value to the WEP line. Without appropriate arrangements with the Government it would not have been possible to furnish these jigs to the contractors on the WEP project.

This bending jig has only been used extensively in the field within the last 2 months. Experience of some contractors shows that time required for bending has been cut in half. It is now estimated that WEP may save nearly $1,000,000 by the use of the jig on the 20-in. line.

For bending the pipe with thicknesses of ⅜ in. and ½ in. for WEP it has not been considered necessary to insert equipment inside the pipe to prevent it from buckling. In preparation for having the new bending jig used on thinner walled pipe for gas lines, the C.R.C. organization has designed a support to serve inside the pipe while it is being bent in order to prevent buckling. When this device is pulled into the pipe, it expands against the inside walls of the pipe. When it is pulled out, the device collapses, making it easy to withdraw.

Pumping Stations of the 24-Inch Crude Line

(Continued from page 178)

Air from the motor room is drawn into each end of a motor and discharged upward through an opening in the top of the motor frame. This is a departure from the normal practice of discharging air downward at each side. As a result, recirculation of warm air through the motors is avoided which might lead to overheating where they are placed as near each other as they are at WEP stations. A forced draft is maintained by an exhaust fan driven by a 1-hp. motor over each 1,500-hp. pump motor. Difficulties are avoided by placing the intake of the large air duct so that it is in line with the air outlet on top of the motor frame but is not directly in contact with it.

All of the large motors have split sleeve bearings and end shields at both ends to aid in inspection and replacement of bearings.

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Cleaning machine in operation

Modern Equipment Speeds Pipe-Line Construction

by M. E. Conkling*

DURING the past few years, slow but consistent progress has been made in the construction of trunk pipe-line systems. Marked improvement in pipe-laying equipment has contributed greatly to that progress.

With the advent of heavier, larger pipe so needful in the war effort, and with the demand for speedy construction, has come especially-built equipment with which to do the job.

Today the contractor gets first-hand information on the terrain across which a pipe line is to extend by the study of pictures taken from airplanes. Irregularities such as creeks, rivers, mountains, highways and railways are discernible. The estimated cost of many projects may be determined from such views of the right-of-way.

Large, fast tandem trucks now transport heavy equipment to the job site, while lighter trucks string the pipe along the line with outstanding speed.

Powerful trenching machines, built to rigid specifications, open the ditch to required width and depth, and do thousands of feet of it per day.

By the electric-arc method the joints of pipe are welded together so well that under hydraulic pull, the pipe will part at any other point before the welded joints will separate.

Welding machines have been much improved. Better governors, sensitive amperage control and increased power all make for better performance; and, too, the electrodes are superior to those of yesteryear. Combined, these factors make possible a large increase in production.

Not long since, pipe had to be cleaned by hand. Scrapers, brushes and other implements had to be used in the operation. Now, a power-driven pipe-cleaning machine traveling on the welded line not only thoroughly cleans the pipe, but a priming attachment covers cleaned surface, preparing it for the painting-and-wrapping machine which follows it.

The last-named machine is also motor driven, and travels on the line. Its purpose is to spray the primed surface of the pipe with hot paint or, as it is commonly called, "dope," just in front of a paper wrapping which covers the paint, thus forming an insulation. A wrapping attachment does the job to perfection and the possible footage is surprising.

Large track-laying tractors equipped with booms cradle the pipe while the cleaning and wrapping machines are working. The completed line is lowered into the ditch as it leaves the cradle, and is ready for the backfill except at certain points where it is placed on skids to provide necessary slack. The slack loops are lowered and covered later.

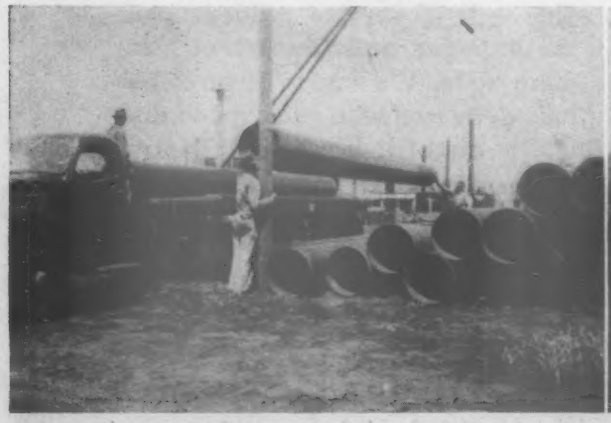
Few changes have been made in the standards of good pipe lining. More and more, however, the stove-pipe method is being used. More welded line and less screw line is the rule. Longer joints of pipe make the going faster. With special tools cold bends are quickly made.

Electrolysis, one of the worst enemies of buried pipe, is being strangled by the "doping" and wrapping process. Electric treatment is also being applied and will, no doubt, in the near future, provide a perfect protection against that dreaded corrosive agent.

It is easy to believe that pipe lines provide not only economical transportation, but safe, fast and dependable service for all petroleum liquids and gases.

The writer believes that pipe-line transportation is in its infancy, and that in coming years more and better systems will be constructed in many sections of the country.

*Manager, United Construction Co.



Unloading pipe from truck

Handling pipe in reclamation yard

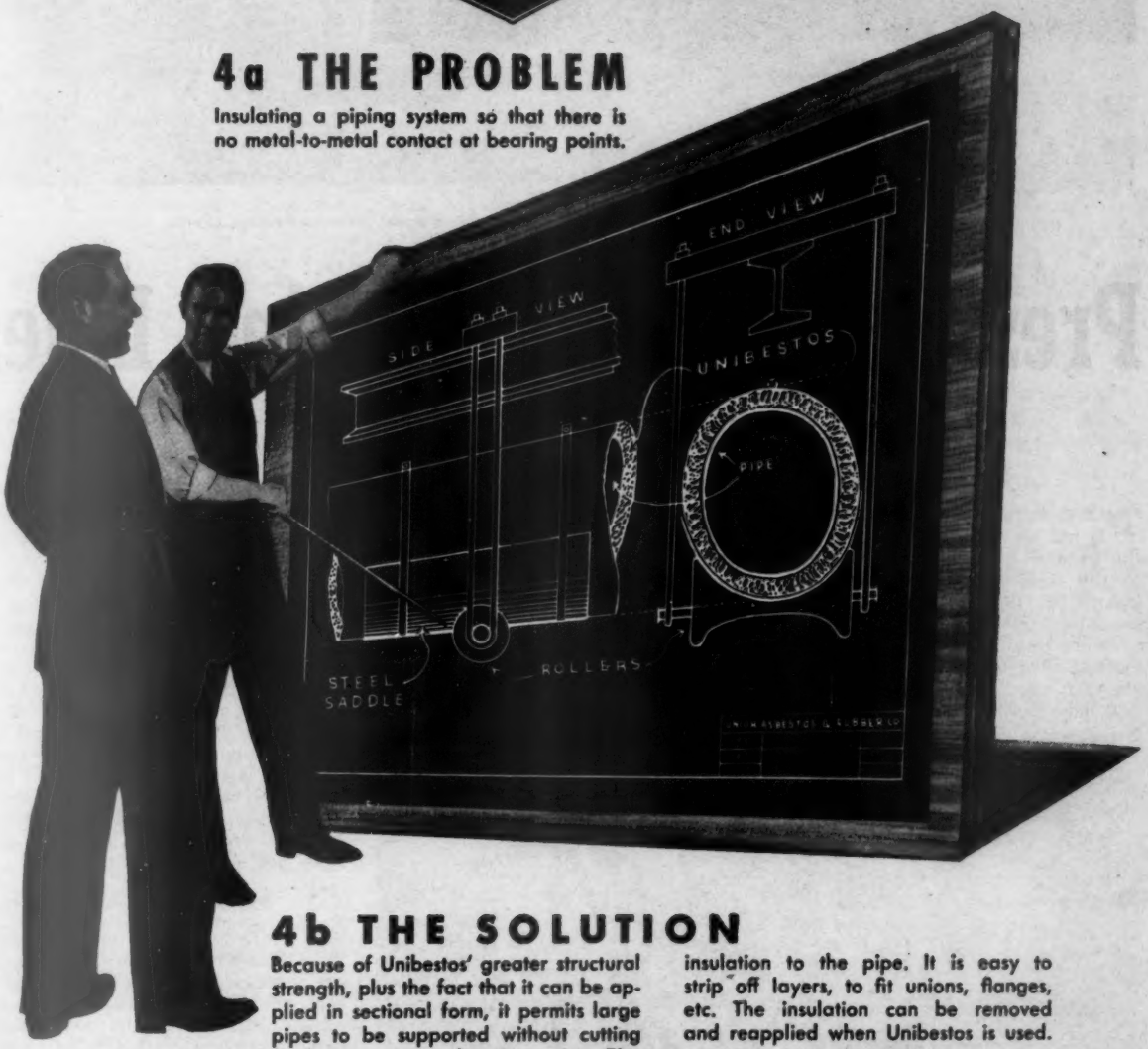
This is the 4TH in a series of messages

DEALING WITH THE PROBLEMS IN HEAT INSULATION FACED BY ENGINEERS AND SOLVED BY USING

UNARCO unibestos

4a THE PROBLEM

Insulating a piping system so that there is no metal-to-metal contact at bearing points.



4b THE SOLUTION

Because of Unibestos' greater structural strength, plus the fact that it can be applied in sectional form, it permits large pipes to be supported without cutting insulation away at bearing points. This is done by laying a steel saddle under the insulation at points where the pipe is supported by rollers, tie rods or other means. This makes it unnecessary to cut away the insulation or to use metal supports that penetrate through the insulation to the pipe. It is easy to strip off layers, to fit unions, flanges, etc. The insulation can be removed and reapplied when Unibestos is used.

unibestos is available in Standard material, for temperatures up to 750°; Super, with a temperature limit of 1200°; Combination, with a temperature limit of 1200°. These temperature limits permit the use of one material at maximum efficiency for a wide range of purposes. Unibestos is available in half sections up to 30" pipe diameter and from 32" to 60" in quadrants from ¾" to 5" in thickness. Standard and Super are available in single layer construction with provision for expansion in piping, where required.

TWO ARMY-NAVY "E" AWARDS FOR EXCELLENCE IN WAR PRODUCTION ONE TO THE CICERO, ILLINOIS PLANT, ONE TO THE PATERSON, N. J. PLANT

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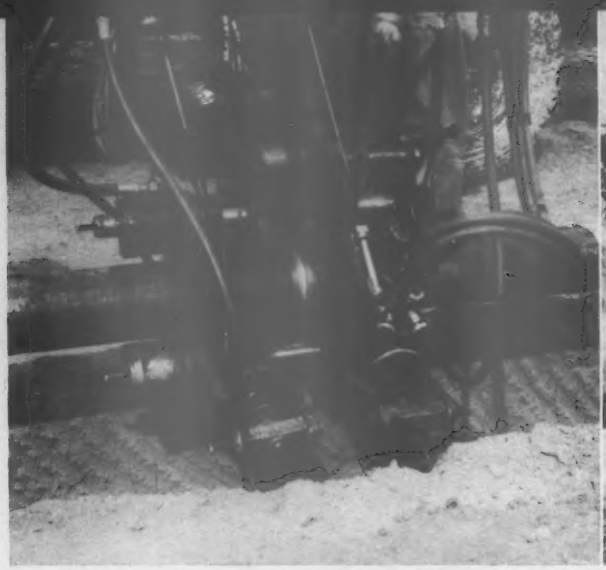


Left—Original Press Weld clamp for 6⅝-in. pipe. Right—Present pressure-welding clamp

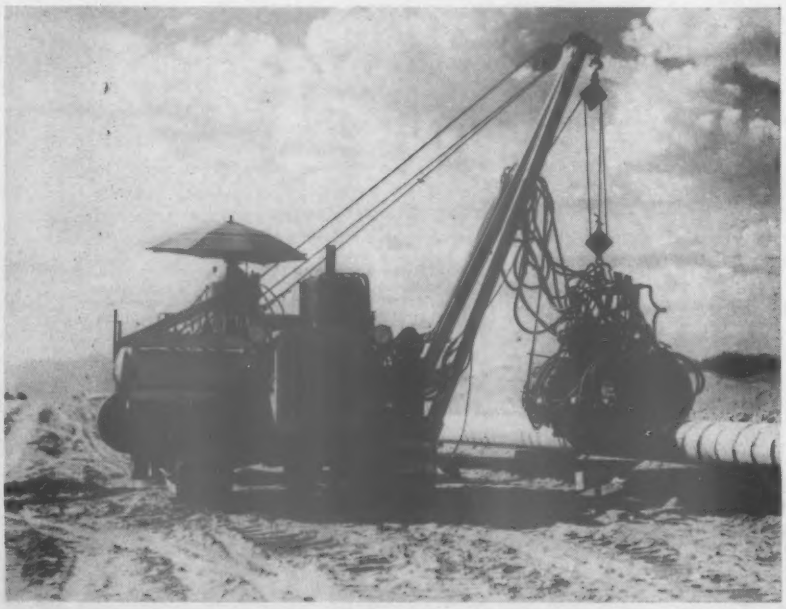
Pressure Welding of Pipe Lines

by A. L. Forbes, Jr.*

THE principle of pressure welding is not new but the adaptation of the process to pipe-line construction in the field is a lusty 2½-year-old infant. Previous articles in the trade press have more or less described the pressure-weld clamp itself and the method of pipe-line welding when the clamp is used. Therefore, this article will deal more with the development of the pressure-weld clamp and with the facts pertaining to the pipe lines which have been pressure welded in the past 29 months.

*Vice president and general manager, El Paso Natural Gas Co.

The pressure-weld clamp was developed by the writer and his associates with El Paso Natural Gas Co. for use in the construction of its pipe lines because it was felt that the pressure-weld clamp would increase the speed and decrease the cost of laying pipe lines.



Sixteen-inch Press Weld clamp carried by tractor

The first overland pipe line welded by means of the pressure-weld clamp was constructed by El Paso Natural Gas Co. for its customer, Tucson Gas, Electric Light & Power Co., in Tucson, Ariz. It was 1.88 miles in length and the pipe was 6⅝-in. o.d. by 0.169-in. wall thickness. The clamp used on this line was designed and built in the company's machine shops at El Paso, Tex. From this small and inconspicuous start in 1941 to August 15, 1943, a total of 655 miles of pipe lines has been welded by means of the pressure-weld clamps. The length, size and wall thickness of such pipe lines are shown in Table 1.

Pressure Weld Clamps

In the construction and welding of pipe lines with pressure-weld clamps, we experienced a large saving in man-hours, of both skilled and unskilled labor, over the conventional method previously used in laying such lines. The use of pressure-weld clamps also eliminated the use of all welding rods and we believed that the universal use of the pressure-weld clamp and method of laying pipe lines would be particularly advantageous to the furtherance of the war effort and, in July 1942, the Pressure Weld Co. was incorporated for the purpose of making its welding service available to others than its parent company, El Paso Natural Gas Co.

Pressure Weld Co. recently completed the welding of an 8⅝-in. o.d. pipe line, 151 miles in length, extending from a point near Mirando City, Texas, across the Rio Grande River to Rosita, Coahuila, Mexico. During

TABLE 1—MILES OF PIPE LINE LAID BY PRESSURE WELDING

Year	Location	Miles	Diam. (in.)	Wall thick. (in.)	Bevel	Remarks
1941	Tucson, Ariz.	1.88	6⅝	.169	Straight	First pipe line
1941	Arizona	5.55	10¾	.203	Straight	
1941	Texas	33.00	16	7/32	4° total	
1941	New Mexico	14.35	16	7/32	4° total	
1941	New Mexico	7.00	6⅝	.1875	4° total	
1941	Arizona	6.12	6⅝	.1875	4° total	
	Total miles of pipe all sizes during year 1941 = 67.99 miles					
1942	Arizona	20.53	6⅝	.1875	4° total	
1942	Texas	1.78	16	.250	4° total	
1942	New Mexico	44.68	12¾	.218	4° total	
1942	New Mexico	3.19	8⅝	.1875	4° total	
1942	New Mexico	10.22	6⅝	⅜ & ½	4° total	Second-hand pipe
1942	N. Texas and Oklahoma	46.10	8⅝	.250	4° total	Used pipe torch beveled
1942	N. Texas and Oklahoma	25.00	10¾	.250	4° total	Used pipe torch beveled
	Total miles of pipe all sizes during year 1942 = 151.50 miles					
1943	Louisiana*	147.00	8⅝	.250	8° total	Used pipe torch beveled
1943	Louisiana*	79.00	10¾	¼ & ⅜	8° total	Used pipe torch beveled
1943	Laredo, Tex.	36.00	8⅝	.203	8° total	New pipe
1943	Republic of Mexico	115.00	8⅝	.187	8° total	New pipe
1943	New Mexico	35.36	8⅝	.203	8° total	New pipe
1943	Arizona	23.26	6⅝	.187	8° total	New pipe
	Total miles of pipe all sizes during year 1943 (August 15) = 435.62 miles					
	Total miles of pipe lines laid to date = 655.11 miles of which 297.1 miles are oil pipe lines and 358.01 miles are natural-gas pipe lines					

*This pipe was double-jointed in yard by pressure welding into 60-ft. joints prior to being hauled to right-of-way.

Test samples of pipe straps cut from weld made by pressure welding

this work careful records were kept and Table 2 is based on these records. In the welding of this line alone, approximately 12,000 lb. of welding rod was saved for use in shipyards and other war plants. A tabulation showing approximate welding-rod savings is shown in Table 3; this table was prepared from construction records of pipe lines built by El Paso Natural during the past 12 years and it is believed the amounts of welding rod shown in the table are generally low.

A comparison of the man-hours required in the construction of the 151-mile line shown in Table 2 with the man-hours required to construct a pipe line of similar size by the conventional method of welding, shows plainly the possibilities in the use of pressure-weld clamps. When making such comparisons, however, it should be borne in mind that the man-hours required do not materially increase with increases in diameter of pipe to be laid inasmuch as all of the pressure-weld equipment is carried on a suitable-size sideboom track-laying tractor. Similarly, the time required to make a pressure weld does not vary with the size of the pipe but does vary, somewhat, with the different wall thicknesses. As an example, below is given the time required for actual heating of various wall thicknesses of pipe, regardless of diameter:

Wall thickness of pipe (in.)	Actual heating time required (seconds)
0.187	37
0.203	42
0.238	50
0.250	55
0.375	70

Starting with one 6⅝-in. pressure-weld clamp, the company now has 10 clamps capable of welding pipe lines from 4½-in. o.d. to 24-in. o.d. Each of the new type clamps will weld two sizes of pipe.

Since the first pressure-weld clamp was constructed in the early part of 1941, numerous changes in design have been made as may be seen readily from the photographs of the first clamp and the present clamp, both for the same size pipe, shown on these pages.

TABLE 3 — SHOWING APPROXIMATE WELDING-ROD SAVING BY USING PRESSURE WELDING

Pipe		Savings of welding rod	
O.D. size (in.)	Wall thickness (in.)	Pounds per weld	Pounds per mile
5	.134	*.20	26.4
	.148	*.33	32.6
6	.148	.35	46.0
6⅝	.148	*.38	50.2
	.169	*.40	53.0
	.187	*.44	58.0
	.203	.63	83.0
	.250	.75	99.0
8⅝	.187	.60	79.4
	.203	.65	86.0
	.250	.85	112.0
10¾	.203	1.1	145.0
	.250	1.4	185.0
12¾	.238	1.53	202.0
	.250	1.67	220.0
16	.238	1.94	256.0
	.250	2.04	270.0

*Oxyacetylene rod. All other figures are electric rod.

Approximately 86,000 lb. or 43 tons of welding rod has been saved by pressure welding so far.

TABLE 2—DATA COMPILED ON PRESSURE WELDING 151 MILES OF 8⅝-IN. PIPE LINE

	36 miles on American side 8⅝-in. x .203 w.t.	115 miles on Mexican side 8⅝-in. x .187 w.t.
Total miles	36	115
Total elapsed days	24	70
Total working days	23	63
Total pressure welds made	3,719	11,558
Total wrinkle bends made	682	870
Average wrinkle bends per mile	19	7.55
Average number pressure welds per day (elapsed time)	155.0	165.0
Average number pressure welds per day (working time)	161.5	183.5
Average pipe line welded and laid complete per day (elapsed time), feet per day	8,000	8,500
Average pipe line welded and laid complete per day (working time), feet per day	8,500	9,450
Total hours pressure weldings	194	515.5
Average number pressure welds per hour	19.2	22.4
Average number skilled labor per day used in line-up, pressure welding, bending and laying*	5	5
Average number semiskilled labor per day for same	3	3
Average number common labor per day for same	4	5
Total skilled man-hours	1,156	3,155
Total semiskilled man-hours	693	1,914
Total common man-hours	925	3,100
Total hours wrinkle bending	37	46
Average number wrinkle bends per hour	18.5	18.9
Actual heating time required per weld, seconds	42	37

*Includes two cat drivers, two pressure-weld operators and line-up foreman.

FABICK'S SERVICE helped build the "BIG-INCH" PIPELINES ★★★

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Assembling a "Cardwell" sideboom on a "Caterpillar" tractor in one of Fabick's service shops.

Each of Fabick's four service shops is completely equipped for servicing "Cardwell" and "Caterpillar" equipment.

An important part in the construction of the "Big-Inch" and "Big-Inch, Jr." pipe lines is being done by the Fabick Tractor Company, "Caterpillar" dealers with headquarters in St. Louis, Missouri.

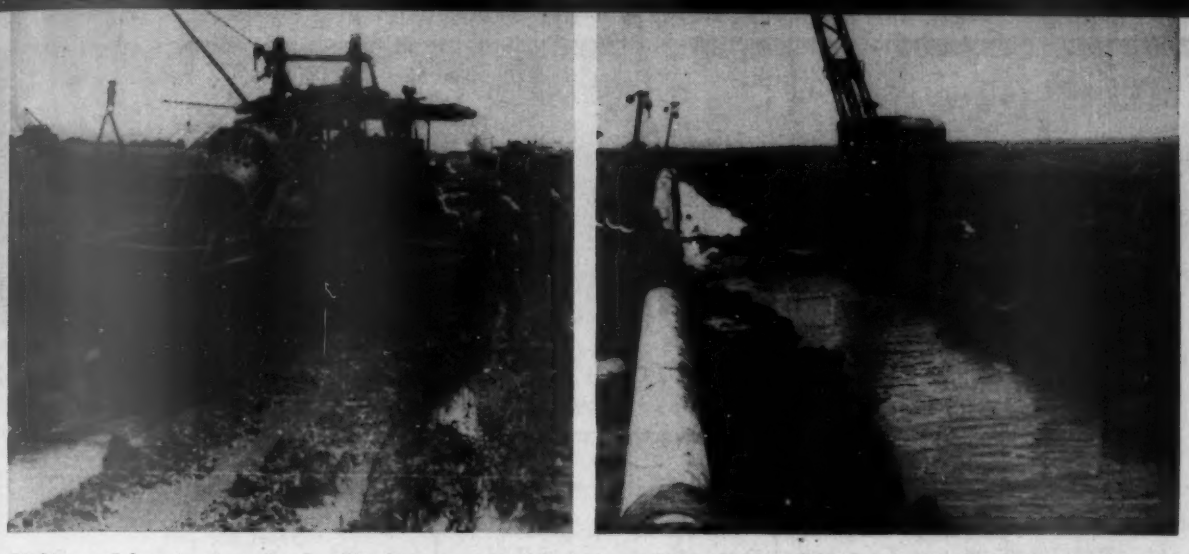
Over 250 pieces of equipment used in the construction of these pipe lines were sold by the Fabick Tractor Company. With each piece of "Cardwell" and "Caterpillar" equipment sold or operating in their territory, Fabick stands behind the contractor with a complete and efficient service organization.

Fabick Tractor Company doesn't dig the ditch or lay the pipe, but they do their part in the construction of these pipe lines by supplying the equipment and keeping it rolling.

Completely equipped for servicing and reconditioning "Caterpillar" Diesel fuel injection parts.

Portable hydraulic track pin press used for disassembling track pins and bushings for "turning" or replacing these parts.

Servicing and tuning up a "Caterpillar" magneto. Special equipment permits faster and more efficient service.



Ditching and lowering in under the difficulties encountered in laying a 16-in. refined products line for War Emergency Pipelines, Inc., across swampy terrain between Baytown to Beaumont, Tex.

Laying War-Emergency Lines In the Gulf Coast Area

***by E. N. Unruh** **

NOTHING is new to the pipe liner. The same old swamps, woods, creeks and rivers are in the way and must be crossed by all pipe lines, including the War Emergency lines. The manner of laying the line has changed but little. The methods have been speeded up by streamlining the equipment.

The spread functions in the usual manner—stringing, ditching, laying, welding, coating field joints, lowering in, backfilling, and last but not least the clean up, for Uncle Sam is very particular how farmers are treated.

Two ditching machines are used in tandem for digging the 24-in. ditch which is never less than 4 ft. deep. The first ditcher digs a full-width ditch about 2 ft. deep; and the second one completes the ditch to the proper depth. The second ditcher carries slopers where there is danger of a cave in or of the ditch sloughing off at the top. Either ditcher is capable of digging the completed ditch without help from the other. This method of tandem ditching reduces the amount of dirt each machine handles and therefore speeds up the forward progress. In case of breakdown in either machine the remaining one can go on alone until the necessary repairs are made and thus save delays. This method also saves extra "roading around" of the machines and thus saves wear and tear on both machines.

The bending operation has been considerably speeded up, and the element of risk in buckling or wrinkling the pipe reduced by the use of a bending machine. This machine has a minimum radius, for any given size of pipe, to which it can be bent with little danger of spoiling the joint or damaging the Somastic coating.

Padded Tongs

The laying has been speeded up by the use of padded tongs or hooks. These hooks allow the work to go on with the use of fewer men and at a more rapid rate. One man and the cat driver can either fasten or remove them with little effort and no loss of time. The padding, which consists of belting fastened to the inside of the hooks, removes most of the danger of damaging the coating.

The time of making the Somastic field joints has been reduced by approximately 50 per cent by the use of water to cool the forms after they are filled with mastic and well tamped. This water is sprayed on the hot form from a hose attached to a tank truck, which follows the coating gang. While the use of this truck necessitates the use of additional equipment, the time saved more than warrants this additional expenditure, as there are fewer holidays and therefore less patching in the joints. The patch boys use butane in small bottles instead of blow torches for heating the mastic while making the patch.

One of the greatest difficulties is getting repair parts for the equipment, which consists of approximately 75 pieces of heavy machinery and trucks, accompanied by many light trucks and pickups. The warehouse in Houston, which by now has become a first-class machine shop, does an excellent job of fulfilling this need. Many of the parts cannot be bought now and so it is necessary for the shop to make them. The machines on the spread are repaired along the right-of-way as is necessary, even to a major repair job. This is accomplished by two trucks equipped with the necessary tools and parts to make the repair. Machines are often repaired before the actual breakdown. This saves many major overhauls and shortens the time the machine is laid up. Trucks and rolling stock of the more mobile type are repaired and adjusted at night at the field warehouse by the night mechanics.

Location of Headquarters

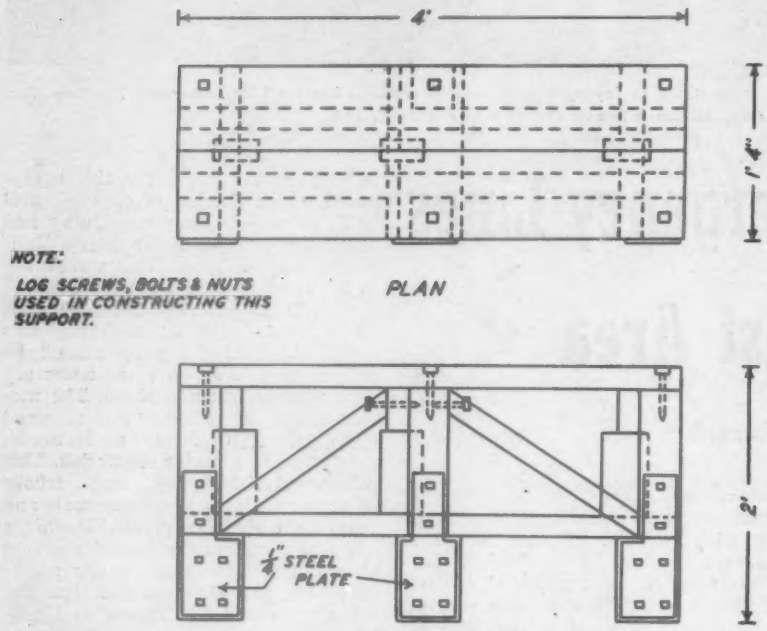
One of the major problems of the spread foreman is locating his field office and warehouse in a location where the men can find living quarters and still be within a reasonable distance of the job. Headquarters moves along as the work progresses, thereby shortening the length of ride for the men to and from work. In the old days camps sufficed, but the modern pipe liner, unlike the old timer, is usually married and his wife travels with him. He likes home-cooked meals, so apartments and houses are required. These are difficult to find in normal times and more so during the present emergency. The spread rarely stays in one town longer than 1 or 2 months at a time.

So the big-inch (as all War Emergency Pipelines seem to be called) goes speedily on its way across the rice fields, pastures and marshes of the Gulf Coast area with the pipe liner crabbing and bemoaning his lot in life, but seldom quitting his chosen occupation for any length of time.

*Field engineer, Sharman & Allen.

PRACTICAL SUGGESTIONS

For the two devices presented here, Pacific Gas & Electric Co. has awarded special prizes in an employe suggestion contest sponsored by the research committee.



Trenching Machine Track Support for Reconditioning

FOR use in trenching next to gas lines which must be exposed for reconditioning work a trenching machine track support was built by Victor Dusio, foreman of the general construction department.

It was used very successfully on 20-in. lines in the Panoche Hills. The trencher is first used along one side of the main. Dirt over the main is pushed into the trencher wheel as this trench is being dug. When the earth has been removed from the top of a suitable section of pipe, the track supports are placed in position. The trencher is then used to excavate a trench on the other side of the pipe. Three sections of the track support are used so that one section is always free to be placed in the advanced position, permitting the continuous operation of the trencher. In the picture one trench has been excavated to the full depth and the earth removed from top of pipe. The trencher is now excavating the other side trench to full depth using the track support for one machine track.

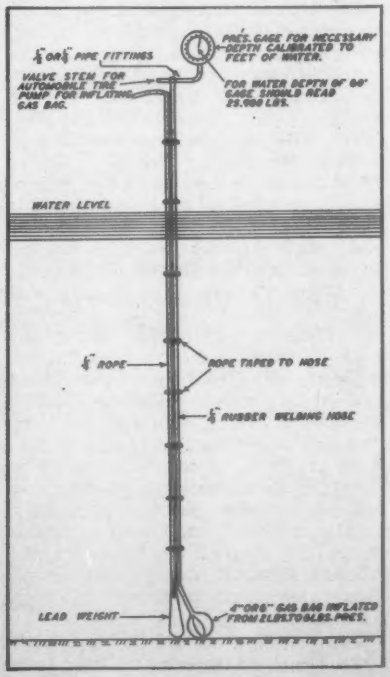
Device for Making Soundings

FOREMAN J. A. OLDHAM, of the general construction department is the inventor of an unusual direct reading sounding device.

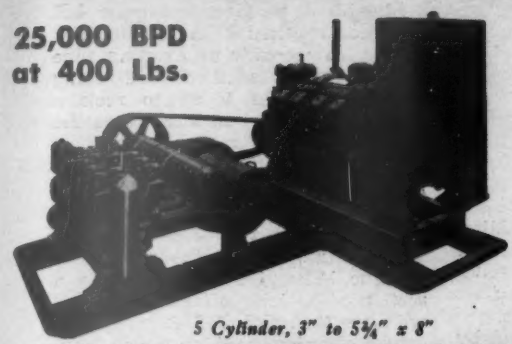
A weighted and inflated ball is connected to a pressure gage. The ball or bladder should be inflated from 2 to 6 lb. pressure. The weighted ball is dropped at the point desired and the depth is indicated on the pressure gage. The pressure gage dial may be corrected to read directly in feet of depth.

This device is superior to the conventional lead and line for taking soundings. Where there is a strong current or tide, or where there is a strong wind, this device can be read quickly and accurately. Many soundings may be taken with this device while one sounding is made with lead and line, under adverse conditions.

This idea has been used very successfully to chart river crossings for laying gas lines.


PRES. GAGE FOR NECESSARY DEPTH CALIBRATED TO FEET OF WATER.
1/4 OR 3/8" PIPE FITTINGS
VALVE STEM FOR AUTOMOBILE TIRE PUMP FOR INFLATING GAS BAG.
FOR WATER DEPTH OF 60' GAGE SHOULD READ 25.980 LBS.
WATER LEVEL
1/4" ROPE
ROPE TAPED TO HOSE
1/4" RUBBER WELDING HOSE
LEAD WEIGHT
4"OR6" GAS BAG INFLATED FROM 2 LBS. TO 6 LBS. PRES.

25,000 BPD at 400 Lbs.



5 Cylinder, 3" to 5¼" x 8"

WHEATLEY QUINTUPLEX PUMP

Description	Liner	Gals. Per Min.	Bbls. Per Hour	Pressure Per Square Inch	Max. H.P. Req'd
	3"	109	156	1605	120
5¼"x 8"—V-Belt Drive	3½"	154	220	1137	120
Fig. 5830	4"	206	294	850	120
Three Cylinder	4½"	265	380	658	120
85 R.P.M.	4¾"	297	424	590	120
	5"	331	473	529	120
	5½"	404	577	434	120
	5¾"	442	631	396	120
	3"	182	260	1605	200
5¼"x 8"—V-Belt Drive	3½"	257	367	1137	200
Fig. 5850	4"	344	492	850	200
Five Cylinder	4½"	442	632	658	200
85 R.P.M.	4¾"	495	707	590	200
	5"	552	789	529	200
	5½"	673	961	434	200
	5¾"	735	1050	396	200

For Main Station, Booster Station or Standby

Designed for Temporary or Complete Replacement Unit

Just off the assembly line is our most recent development: a pump weighing less than 13,000 lbs., capable of developing 1000 bbls. per hour at 400 lbs. pressure, with five individual fluid cylinders and twenty individual valves in pot type fluid cylinder.

LESS WEIGHT SURGE **MORE** VOLUME PRESSURE

- TEN IMPULSES TO ONE TURN OF CRANKSHAFT AT 85 R.P.M.
- REDUCES SURGE CONDITIONS TO A MINIMUM
- INDIVIDUAL AND INTERCHANGEABLE PARTS

Designed to operate as two distinct units if desired, by placing a valve between the set of 3 cylinders and the set of 2 cylinders. These sets can operate with each having a different size liner making it possible for this unit to develop two different pressures at two different volumes.

Interchangeable liners in half-inch graduation from 3" to 5¾" with an 8" stroke, giving wide range of pressure and capacity.

ALSO AVAILABLE IN 3 CYLINDERS

(AND A 2½" to 4" x 6" IN 5 CYLINDERS)

LARGE CAPACITY ● PORTABLE UNIT

Quickly loaded complete with engine on one truck, within highway load, width and height limits. Complete details on application. Write for Bulletin J-943.

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2½" to 4" x 6" V-Belt or Direct
46 BPH at 1120 lbs.
125 BPH at 417 lbs.

3" to 6" x 8" V-Belt or Direct
68 BPH at 767 lbs.
288 BPH at 181 lbs.

2½" to 5" x 10" Direct Drive
59 BPH at 1325 lbs.
278 BPH at 330 lbs.

2½" to 7" x 10" Direct Drive
92 BPH at 920 lbs.
557 BPH at 168 lbs.

2½" to 5" x 10" V-Belt
59 BPH at 1400 lbs.
278 BPH at 405 lbs.

3" to 7" x 10" V-Belt
92 BPH at 1203 lbs.
557 BPH at 202 lbs.

2½" to 7" x 10" V-Belt
92 BPH at 1400 lbs.
557 BPH at 303 lbs.

3" to 8" x 10" V-Belt
92 BPH at 1400 lbs.
733 BPH at 230 lbs.

TRIPLEX AND QUINTUPLEX PUMPS

TRIPLEX

3" to 5¼" x 8" V-Belt Drive
156 BPH at 1605 lbs.
631 BPH at 396 lbs.

QUINTUPLEX

2½" to 4" x 6" V-Belt
199 BPH at 1500 lbs.
555 BPH at 600 lbs.

3" to 5¼" x 8" V-Belt
260 BPH at 1605 lbs.
1050 BPH at 396 lbs.

See Quintuplex Table above

OTHER WHEATLEY PIPE LINE SPECIALTIES

- **STRAINERS**
  Oil and Gasoline
  Single and Twin
  Horizontal or Vertical
- **GATE VALVES**
- **STEEL HALF SOLES**
- **COLLAR WRAPS**
- **WELDING SLEEVES**
- **PLUG VALVES**
- **ORIFICE FLANGES**
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Arc Welding Accelerates Laying of Pipe Lines

*by C. M. Taylor**

THE speed and economy of arc welding for the construction of pipe lines of practically any size are evidenced by the thousands of miles of additional lines that have been laid during recent months.

The recently completed "Big Inch," largest pipe line in the world, furnishes a good example of the rapid construction made possible by the modern shielded-arc process. The line which is 1,251 miles in length and traverses nine states, was finished in 360 days despite delays due to floods. Arc welding not only made this record construction speed possible but it also resulted in unexpected economies.

The WEP line is of 24-in. diameter pipe with a wall thickness of ⅜-in. and is in 50-ft. sections. The trend toward welding without the use of back-up rings, even on such larger sizes of pipe, was evidenced in this huge construction job, and partially accounts for the fact that this practice had almost disappeared in present-day pipe-line construction. Elimination of back-up rings is a definite advantage in that it reduces installation cost and does not retard the flow of oil or gas through the line.

Effective results were obtained by combining the increasingly popular stovepipe method of welding with the firing-line (roll-welding) method. The first complete weld is made with 5/32-in. general-purpose electrode for mild steel, with the welder set at 200 amp. For the second pass, the same type electrode in the ¼-in. size is used, with an amperage of 325. The joint is then finish-welded by using a 5/32-in. electrode size.

Where firing-line welding is used tractors carry the three welded pipe sections to the end of the line where they are lined up and clamped. The pipe is bell-hole welded, two welders working simultaneously on both sides of the joint, making a complete bead, each welder working down from the top.

In particularly rough terrain, the bell-hole method is used exclusively, one 50-ft. section of pipe being welded to the end of the line at a time.

Further general use of diesel engines for supplying electric power to welding machines has also been strongly in evidence recently.

Simplified welding technique has also been responsible in effecting fast economical repairs to existing pipe lines. Various methods are being successfully used today to reclaim corroded pipe and in most cases the corroded pipe is made as good as new, at substantial savings over replacement costs.

Ordinarily, oil lines can be reconditioned by means of arc welding without interrupting the service of the line. The pipe is first dug up, a section at a time. All dirt, rust and scale are then removed. A gas-engine driven cleaning machine which travels on the pipe is usually used on more extensive pipe-reclaiming operations.

If pits or corroded areas are deeper than 10 per cent to 15 per cent of wall thickness it is repaired. The speed in filling pit holes by welding lessens the possibility of burn-through.

Pipe Repair

Half-soles are cut out of new pipe of the same diameter and thickness as the one to be repaired. After clamping them into place, the half-soles are tack welded, the clamps removed and then permanently arc welded along all seams. For the first bead, a 5/32-in. shielded arc electrode for mild steel is used. The second bead is made with a ¼-in. size. Vertical and overhead welds are usually laid with 5/32-in. electrode.

Steel half-sole jackets are originally used when bad leakages occur at the collars.

A rapid gain in arc welded repair of gas lines has also been noted recently. One company does all repair work in the field using practically the same procedure as where the central plant method is used.

A 16-in. line illustrates a present-day welding procedure for gas-line repair. The line is 25 miles in length and was originally laid some 25 years ago in 20-ft. lengths with the coupling method of joining.

In the current maintenance work a ditch is first dug and the pipe lifted to timber supports over the ditch. Coupling bolts were then cut off with a torch and pipe cleaning was done with the aid of pointed hammers and chisels to remove encrusted particles. All corroded areas were marked and thoroughly cleaned.

The pipe was then mounted on dollies and roll welded, using two passes of 5/32-in. shielded arc electrode for mild steel. The same type and size rod was used to fill in corroded pits which varied in size.

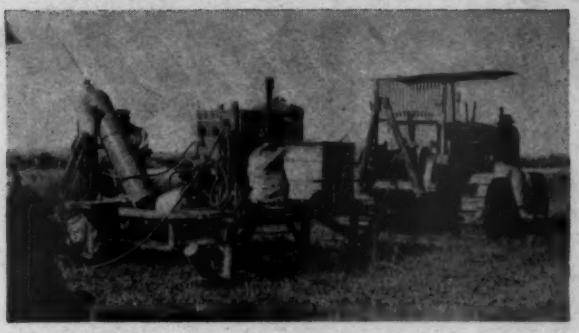
The finished job was said to be superior to the new original line.

Fig. 1—Roll welding three sections of the Big Inch pipe line before tying into the completed line

*Vice president and sales manager, Lincoln Electric Co.

PRACTICAL SUGGESTIONS

Facilities For Transporting Welding Equipment in Laying the WEP Lines



THE tow tractor pulling the sled containing welding equipment has a grill, behind the driver, made of short pieces of pipe for the purpose of protecting the driver against injury in case a cable breaks which is used in towing. It may be observed that the cylinder to hold gas used in cutting is held on the sled by an H-shaped support in such a way that the cylinder is transported in a tilted position.

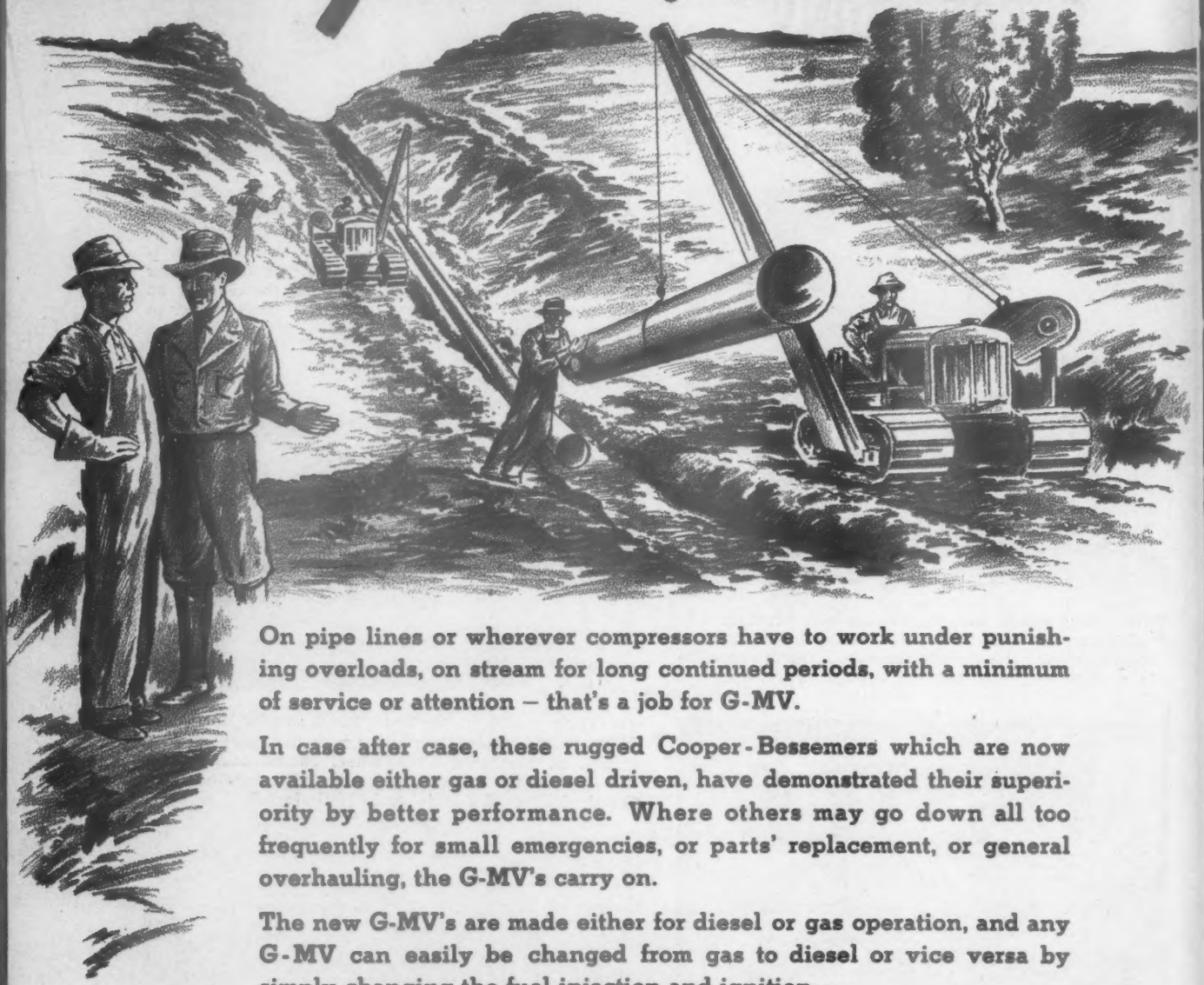
THE utility truck has the cutting and beveling machine boxed in a convenient manner so that it may be tied alongside the electric generator. On the opposite side, welding clamp is laid in a horizontal position.

IN laying the 24-in., the 20-in. and a smaller line across the Susquehanna River in Pennsylvania, supplies were carried in contractor's rear-wheel paddle boat, "Half-Inch," chain-driven by automobile engine, smallest of a fleet including "Big-Inch" and "Little-Inch."

IT has been found more convenient to carry the heavy welding clamp used for large-diameter pipe on a support at the rear end of the truck. This support is made of a short piece of pipe of the size on which it is intended to serve. When in place, the clamp is in a vertical position where it can be easily put on and taken off. At all times while in transit it is held rigidly in place by means of the clamp gripping the short section of pipe in the manner in which it is used in the field.

SHADE for the welder at one of the gangs working on the WEP 20-in. line is furnished by placing fresh-cut saplings on the side of the sled holding the welding equipment. In this way, the shade is more extensive than can be obtained from an umbrella.

Give your TOUGH



On pipe lines or wherever compressors have to work under punishing overloads, on stream for long continued periods, with a minimum of service or attention – that's a job for G-MV.

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Heaters on Natural-Gas Transmission Line

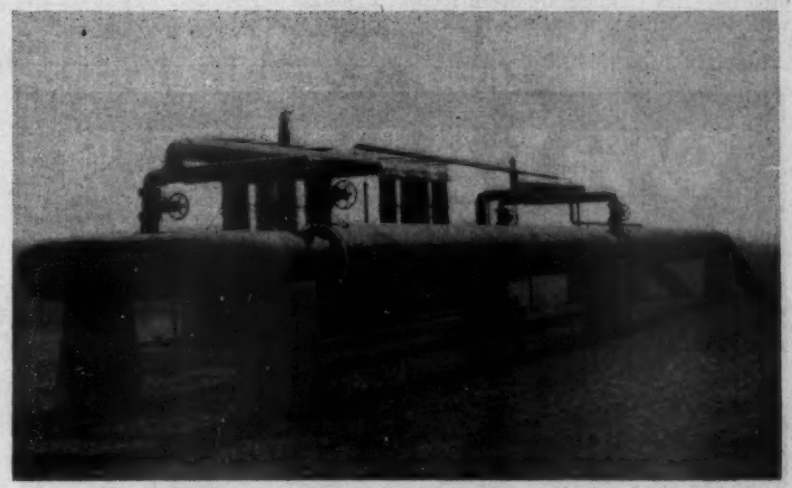
by Frank Wills*

IN 1942 when the new 16-in transmission line from the west side of the Rio Vista field was being planned, the probability of hydrate formation was evident. In fact, the Natural Gas Corp. line from the east side had experienced hydrate trouble during the preceding winter. The peak velocities in this line and that contemplated in the proposed line were quite high. The new line under peak load was expected to carry 9,500,000 cu. ft. of gas per hour with an inlet pressure of 780 lb. per sq. in. and 500 lb. per sq. in. at the Antioch Control Station, 58,000 ft. from the field. With a drop of 5 lb. per sq. in. per thousand feet considerable temperature reduction along the line was anticipated.

The probable temperatures enroute along the line were estimated by R. V. Dunkle. Data taken from the Natural Gas Corp. line were used as a check upon the method and assumptions involved in these calculations. Details of this are available in the 1942 Proceedings of the Pacific Coast Gas Association, page 46.

Past experience on lower rates of withdrawal from the west side field indicated that an inlet gas temperature of about 60° F. would be possible. The lowest ground temperature in this region was about 50° F. and two river crossings were involved. The pressure reduction at the con-

*Engineer of Production, Pacific Gas & Electric Co.



Heater on 16-in. transmission line near West Rio Vista field

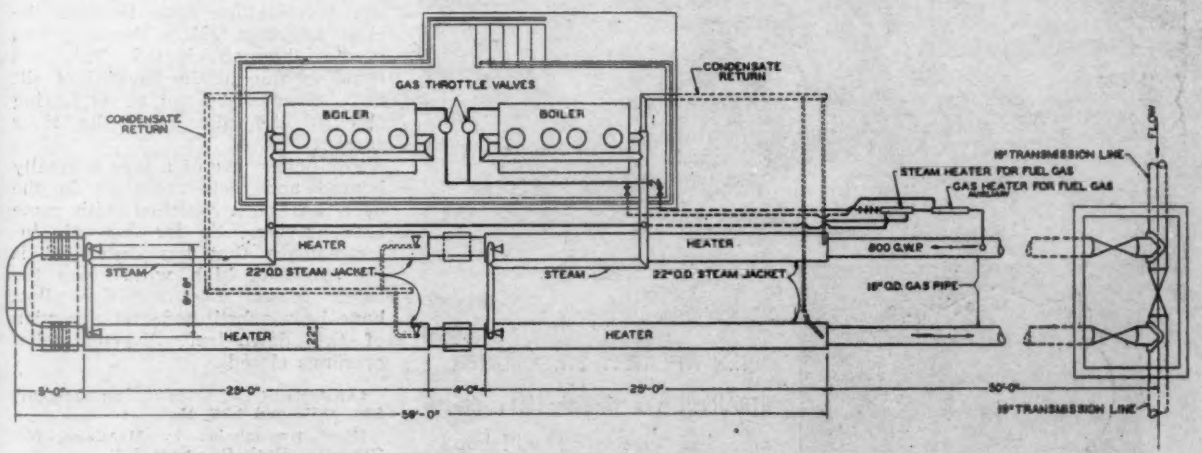


Fig. 1

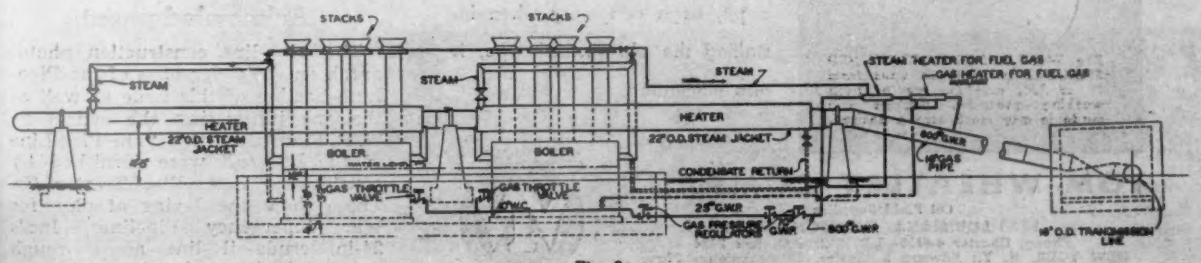


Fig. 2

trol station would vary from nothing during the peaks to 220 lb. per sq. in. on light loads.

It appeared advisable to provide a heater at the control station ahead of the regulators to prevent hydrates during periods of pressure reduction, and another heater near the field to prevent the formation of hydrates in the line between the field and station for use during periods of high rate of flow and low ground temperatures.

The heaters at each location consist of four 25-ft. sections of 16-in. pipe in series forming a hairpin loop with two sections in each leg. Each section is jacketed with 22-in. pipe, insulated and weatherproofed on the outside. The exterior surface of the 16-in. pipe and the flanges to which the outer jacket is welded are galvanized. Low-pressure steam is supplied to the annular space from cast-iron boilers. The piping is so arranged that steam may be applied to any or all of the sections, as required. The general principle is that of a steam heating system with the heater sections above ground and the boilers in a pit; the whole being in the open without cover.

The heating surface was calculated using a steam side coefficient of 2,000 B.t.u. per sq. ft. per hour per degree temperature difference, and a gas‡ side coefficient obtained from the following simplified formula:

$$‡\ h = 0.004\ (Re)\ 0.8/D$$

h=Btu./sq. ft./Hr./°F
Re=Reynolds No.
D=Diam. inches

The heating surface so estimated seemed rather small and since no data were available on a pipe line as large as 16-in., the amount installed was double that calculated.

Actually four such heater installations have been made. The Natural Gas Corp. line from the east side was revamped and then taken over by Standard Pacific Gas Line, Inc. Two heaters also were placed on this line; one near the field and one at the Antioch Control Station.

Figs. 1 and 2 show diagrammatically the plan and elevation of the layout representative of each installation. These are in sufficient detail to provide a basis for design of similar installations.

The weather during the past winter was not severe and the temperature of gas from the field was higher than anticipated, consequently none of the heating layouts have been operated to their full capacity. Sufficent data were obtained, however, to check the calculated temperature drop along the line and the over-all heat transfer in the heaters. In both instances the performance was in close agreement with the theoretical computations with the exception of the temperature drop through the river crossings. Here the drop was greater than anticipated. This was probably due to the backfill of silt in the river bottom not, as yet, having shielded the pipe from the river current.

The boilers are of a type normally housed and their operation in the open has been watched with some apprehension. So far the only inconvenience that has developed is the effect of high wind upon the safety pilots. Less sensitive pilots have been substituted and a portion of the down-draft diverter relief openings closed.

†Analysis of Rio Vista gas is: 93.5%CH_4, 5.2% C_2H_6, and 1.3% N_2.

‡Heat transmission by McAdams, McGraw-Hill Book Co., page 172.

Acknowledgment

The pipe-line construction photograph on the cover page of the Pipe-Line Section of this issue as well as the one illustrating the article by W. R. Finney, entitled, "The Pipe Line of the Future," were furnished by courtesy of Caterpillar Tractor Co. These show the laying of pipe for War Emergency Pipelines, Inc.'s 24-in. crude-oil line across rough country in Pennsylvania.

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Purchased Electric Power Helps Bayou Line Fill War Assignment

by E. L. Robinson *

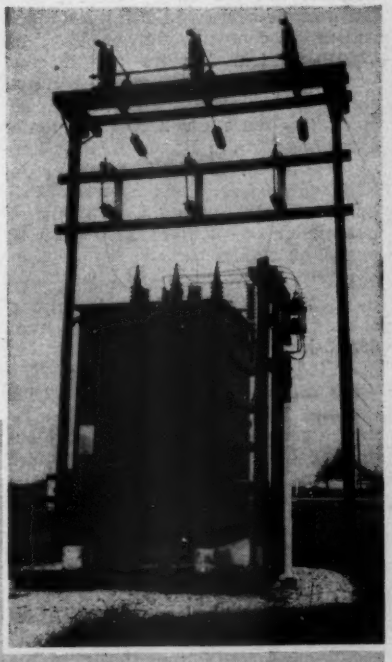
AT the request of the Petroleum Coordinator for War, six oil pipe line companies, Shell, Texas, Pan American, Crown Central, Pure and Humble, financed and built the Bayou Pipe Line System, a rush job to help the war effort by delivering refined petroleum products from the Houston-Texas City and Beaumont-Port Arthur refining areas to the Plantation Pipe Line at Baton Rouge for further movement to the critically short eastern seaboard area.

After the six participants had worked out their ownership interests and had selected Shell to handle the construction, one of the immediate problems to be settled was the question of type of prime movers and power for operating the 11 pump stations. Shell's immediate decision, based on a survey of the second-hand equipment available, was to use electric motors and to purchase electric power. The matter of a power supply was immediately referred to the three major electric public-utility companies serving the area to be traversed by the new line. After approval of the proposal by WPB's power branch, these companies at once set about to obtain right-of-way for the necessary 35 miles of transmission lines, and to purchase and assemble the needed line material.

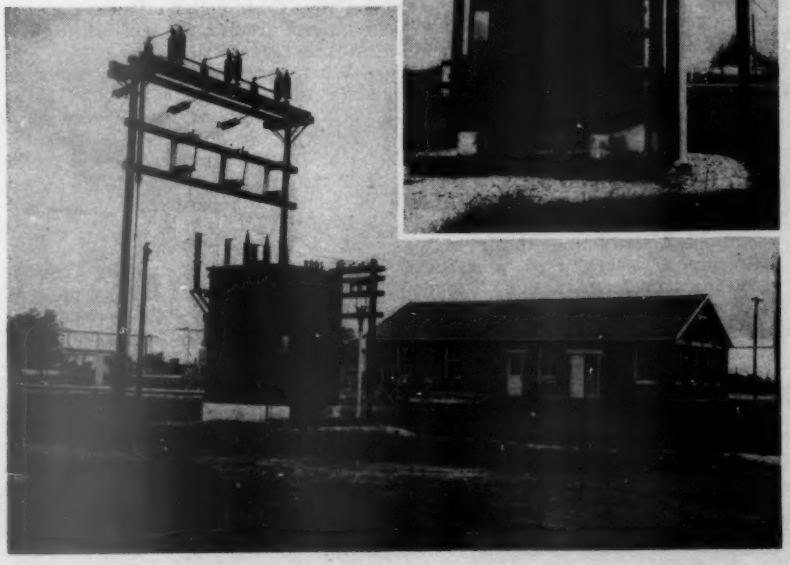
As in the case of the pipe line proper, the greater portion of all line material necessary for the construction of the power services was secured by taking down older lines from where they were not being used, and transferring the salvaged material to the new locations. Three complete substations also were secured in this manner, and practically all of the switching equipment necessary was secured from excess stocks or removed from other lines. The use of this material increased labor costs, but on the other hand no delay was experienced in its delivery, and a great saving of critical metals for the war effort was accomplished.

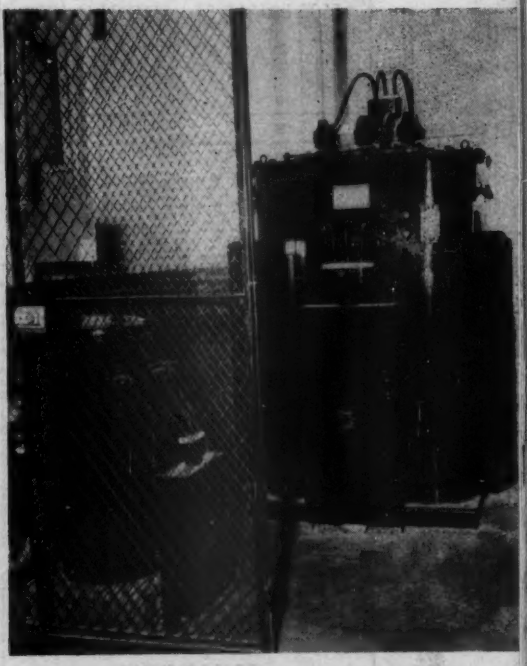
The job of continuously supplying 8,000 kw. of energy to the 11 stations represented a sizable undertaking on the part of the electric companies

*Gulf States Utilities Co.



Right: Features of the 1,000-kva. 66/2.3-kv. "unit type" substation are the concrete pedestal, for mounting the unit, as well as the "H" frame and short structure on one side of the unit on which pot head and riser for underground feed are terminated





Above: Three-phase 2,300/440-volt transformer installed in pump station control room to furnish 440-volt service for tank booster pumps, sump pumps and miscellaneous power uses in the tank farm and around the station. The small single-phase 2,300/110-volt transformer at the left furnishes station-lighting service

Left: The 1,000-kva. 66/2.3 substation showing Bayou Pipe Line System pump station and manifold in the background

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whose facilities have already been greatly extended to supply large blocks of power for various war industries including shipyards, oil refineries, steel mills, magnesium plants, rubber synthesis plants, steel-fabricating plants, oil-field production, oil pipe lines, chemical plants, air fields, schools, bases and camps for the armed forces, and almost every conceivable type of war load. The electric company's approach to the problem was that it was their obligation to supply and eagerly set out to serve war loads of whatever nature and, through coordinated effort, to utilize their generating and transmission facilities to see that power was made available.

Trunk-line movement on the Bayou system starts at the terminal station in Baytown. This section has three stations, including that at the terminal. The Baytown station, powered by two 350-hp., 3600-rpm. motors and one 400-hp., 1800-rpm. motor, is served at 12 kv. by Houston Lighting & Power Co. The substation and transformers here are owned by Bayou, having been furnished by one of the participants. The two intermediate stations at Hankamer and Fannett are served by Gulf States Utilities Co. from 33-kv. lines, each substation comprising three 200-kva., 33/2.3-kv. transformers and a conventional steel structure. These two substations — owned by the power company—were on hand and made available for the Bayou installations by action of one of the participants. Each of these stations uses two 350-hp., 3600-rpm. motors. All major equipment operates at 2300 volts, 3 phase, 60 cycles.

The Port Neches station is served by Gulf States Utilities Co. from a 66kv. line through a 1,000 kva., 66/2.3-kv. "unit-type" substation mounted on concrete pedestals. The piece of equipment weighs 62,000 lb., and its foundation—designed by the power company—facilitated placing the heavy unit with a minimum of handling. Similar foundations were used by Gulf States for similar but lighter 1,000-kva., 33/2.3-kv. substations installed at Vinton, Buhler, Edna, Lawtell, Courtableau and Erwinville.

A unit-type substation is a three-phase transformer built into a single metal case containing the necssary lightning arresters, fuse protection, metering transformers, etc. The design is such that substantially less critical material is used as compared with a bank of three single-phase transformers with conventional substation bus work, switch gear and related equipment of equal capacity. This saving in critical material and in man hours of installation crews dictated the use of this type of equipment where purchase of new voltage transformation facilities was necessary.

The Basile station is served by Gulf Public Service which, in turn, purchases the necessary power from Gulf States Utilities Co. at Crowley, La. Basile is served through a bank of three 333-kva., 33/2.3-kv. transformers which the utilities company had.

Centrifugal pumps are used for all main-line pumping on the system, and they as well as most of their motors and starters are second-hand equipment furnished by one of the six participating companies. It was necessary to design the 10-in. line around the pumping equipment available, and this resulted in the odd-numbered stations on the 10-in. line being provided with two 400-lb.-per-sq.-in.-pumps in series driven by 500-hp., 3,600-rpm. motors, and the even-numbered stations being provided with two 300-lb.-per-sq.-in. pumps in series driven by 400-hp., 1,800-rpm. motors. As on the 8-in. line, all are 2,300-volt, three-phase, 60-cycle equipment. In some cases on both lines the motors and starters were borrowed in order to get operation started as quickly as possible, and these were replaced as fast as new equipment could be obtained.

At both the Baytown and Port Neches terminals the product stock tanks are connected in pairs through centrifugal booster pumps aimed to hold a uniform pressure on the terminal pump station suctions. There are centrifugal units driven by 50 and 75-hp., 3,600 rpm., 440-volt motors fed through secondary 2,300/440-volt, three-phase transformers.

Metering at each electric substation is at 2,300 volts. The metering equipment on the conventional-type substations is mounted in the substation fence so as to be accessible to the engineers who take regular readings. On the unit-type subtstations, the equipment is "built in" and is mounted on one side of the transformer case. These are readily accessible inasmuch as fences are not required around the substations for electrical protection.

Wherever possible the substations have been located within 25 ft. of the pump stations to conserve lead-covered cable and other critical material for the underground feed to the station switchboard. Disconnect switches are mounted on poles outside of the pump stations. These provide a means of killing all service to the station if emergency requires such a measure.

The early decision of Shell to use electric power, and the prompt response of the electric companies in engineering the problem and working out contract arrangements, enabled power to be made available at every station when needed. This coordination of effort enabled both sides to complete a difficult wartime job in short order in spite of current shortages of men, material and equipment.

Design of a Large-Capacity Steam-Gas Line Heater

by Max K. Watson and Bernie B. Morgan†*

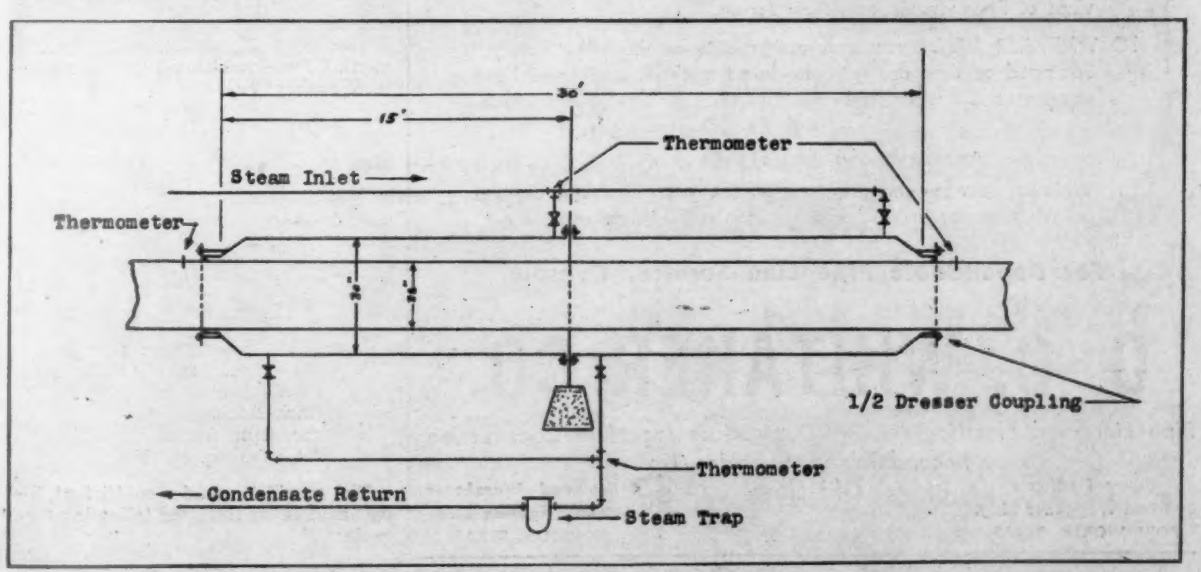
THE problem of heating a large volume of gas under comparatively high pressure in pipe lines of various diameters is not new in the transmission of natural gas and has been accomplished in numerous installations by the use of direct fire, steam, hot water or other hot liquids in various types of heat transfer equipment. The installation treated in this article is of special interest because of the use of a minimum of critical materials in its construction which is of major importance during the present emergency.

The problem was to increase the temperature of approximately 115,000,000 cu. ft. of gas per day in a 22-in. pipe line operating at approximately 300 lb. pressure. This specific installation required only a few degrees increase in temperature on the gas entering a calcium chloride dehydration plant where low atmospheric and gas temperatures were causing a freeze up due to gas hydrate formation in the inlet connections and bottom of the calcium chloride contactor. The heat transfer data, however, are applicable to any gas-heating problem where even higher gas temperatures are required, as in the case of regulator stations.

*Assistant general superintendent. †Gas engineer, Canadian River Gas Co.

A conventional design would be multitube heat exchanger with thin wall tubes installed on a bypass requiring main-line block gates and a large quantity of pipe and fittings. However, the equipment in this case consists of only two 30-in. by 15-ft. insulated jackets surrounding the 22-in. pipe. Such an installation has an added advantage of obtaining the desired heat transfer without loss in gas pressure usually obtained in a typical heat exchanger. The end connections

View of main-line gas heater



Steam-gas heater

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between the 22-in. pipe and 30-in. jackets were made by swaging and welding the jacket on one-half of the 22-in. Dresser sleeve. Bolts for the followers were welded into the outside shell. This permitted lateral expansion and contraction of the shell. The shell was made of ¼-in. steel, rolled and welded on lateral seams. A center wall or baffle was welded to the 22-in. pipe and the two jacket sections bolted to this center baffle by means of angle irons welded to the shell to form a flange in which gaskets were installed.

Purpose of Baffle

The purpose of the baffle was to act as a leg in supporting the center weight on a pedestal and to permit the use of one-half of the heater on varying loads. The actual design calculations indicated a heater 15 ft. in length but, since this heater could not be removed from the pipe line, a duplicate was provided for an emergency and so connected that both sections could be used independently or in series as conditions warranted. Such a design further provided a factor of safety to insure continuous operations of the pipe line during the following winter. Inlet steam connections and outlet condensate connections were provided for each section and the condensate returned to the boiler makeup tank through a conventional steam trap. The outside of the shell was insulated to conserve steam. Steam was obtained from a 30-hp. boiler at 15 lb. pressure located approximately 300 ft. from the pipe line; however, the required boiler capacity will vary with the size of the heater and the amount of heat to be added to the gas. The heater was installed directly in the main line by removing two joints of 22-in. pipe and inserting the jacketed section. No other pipe-line changes were required.

The over-all heat transfer coefficient, U, was calculated by the resistance concept or

$$\frac{1}{U} = \frac{1}{h_s} + \frac{L}{k} + \frac{1}{h_r} \qquad (1)$$

where

- U = over-all heat transfer coefficient; B.t.u./hr./sq. ft./°F.
- h_s = 1,000 = condensing steam transfer coefficient (including scale on pipe), B.t.u./hr./sq. ft./°F.
- L = .375 = thickness of pipe (in.)
- k = 360 = steel heat conductivity coefficient, B.t.u./hr./sq. ft./°F. (inch thickness)
- h_r = gas film transfer coefficient; B.t.u./hr./sq. ft./°F.

The gas film transfer coefficient, h_r, was calculated from the following formula:*

*Principles of Chemical Engineering, 1937, p. 113, by Walker, Lewis, McAdams & Gilliland.

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$$h_f = \frac{0.0144\, C_p\, G^{0.8}}{D^{0.2}} \qquad (2)$$

where
h_f = gas film transfer coefficient, B.t.u./hr./sq. ft./°F.
$C_p = 0.540$ = specific heat of natural gas
G = mass velocity, lb./hr./sq. ft. (cross-section area)
D = 1.8 = internal diameter of pipe (feet)

(Continued on page 220)

TABLE 1—EVALUATION OF GAS FILM HEAT TRANSFER AND OVER-ALL HEAT TRANSFER COEFFICIENTS

Q at 16.4 M.c.f. per day	G Lb./hr.	G lb./hr./sq. ft.	$G^{0.8}$	h_f B.t.u./hr./sq. ft./°F.	U
50,000	122,000	47,900	5,550	38.5	35.6
60,000	146,400	57,300	6,495	45.1	41.1
70,000	171,000	67,200	7,276	50.4	45.8
80,000	195,000	76,600	8,069	55.9	50.6
90,000	219,000	86,200	8,880	61.5	54.5
100,000	244,000	95,800	9,663	67.0	58.7
110,000	268,500	105,500	10,440	72.4	62.8
120,000	292,500	115,000	11,180	77.5	66.6

TABLE 2—ACTUAL TEST DATA—22-IN. BY 15-FT. STEAM-GAS LINE HEATER

Test No.	Inlet temp. Steam T_1	Inlet temp. Gas t_1	Outlet temp. Condensate T_2	Outlet temp. Gas t_2	M.T.D.	Q M.c.f. per day at 16.4 lb.	$t_2 - t_1$	U
1	254	48.5	224	57.5	186.5	.....	...	...
	254	48.5	224	57.5	....	.....	...	...
	254	48.5	224	57.5	....	.....	...	...
Average test No. 1					186.5	76,000	9.0	56.9
2	246	48.5	210	56.75	175.0	.....	...	...
	246	48.5	207	56.75	173.3	.....	...	...
	245.5	48.5	206	56.75	173.0	.....	...	...
	245.5	48.5	205	56.75	171.8	.....	...	...
	245.5	48.5	204	56.75	171.3	.....	...	..
Average test No. 2					172.6	76,400	8.25	56.6
3	243.5	48.5	204	56.5	170.5	.....	...	...
	242.0	48.5	202	56.5	168.3	.....	...	....
	241.5	48.5	201	56.5	167.3	.....	...	...
	241.0	48.5	200	56.5	166.3	.....	...	...
	242.0	48.5	199	56.5	166.7	.....	...	...
	242.0	48.5	198	56.5	166.2	.....	...	...
	242.5	48.5	196	56.5	165.0	.....	...	...
	243.0	48.5	196	56.5	165.4	.....	...	...
	243.5	48.5	196	56.5	164.8	.....	...	...
Average test No. 3					166.7	76,000	8.00	57.0
4	242.0	49.0	214	56.75	175.5	.....	...	...
	240.0	49.0	209	56.75	166.0	.....	...	...
	240.0	49.0	209	56.75	166.0	.....	...	...
	242.0	49.0	208	56.75	172.0	.....	...	...
	242.5	49.0	204	56.75	170.0	.....	...	...
	242.5	49.0	204	56.75	170.0	.....	...	...
	243.0	49.0	204	56.75	169.3	.....	...	...
	243.0	49.0	207	56.75	170.4	.....	...	...
	242.5	49.0	208	56.75	172.3	.....	...	...
	242.5	49.0	206	56.75	171.0	.....	...	...
	243.0	49.0	206	56.75	171.4	.....	...	...
	243.0	49.0	206	56.75	171.4	.....	...	...
Average test No. 4					170.4	91,500	7.75	64.6
5	254	49.0	233	57.0	190.0	.....	...	...
	254	49.0	233	57.0	190.0	.....	...	...
	254	49.0	233	57.0	190.0	.....	...	...
	254	49.0	233	57.0	190.0	.....	...	...
	254	49.0	234	57.0	190.2	.....	...	...
	254	49.0	234	57.0	190.0	.....	...	...
	254	49.0	233	57.0	190.0	.....	...	...
Average test No. 5					190.0	98,000	8.0	64.5
6	242	49.0	214	56.0	175.0	.....	...	...
	242	49.0	210	56.0	173.0	.....	...	...
	241	49.0	204	56.0	170.8	.....	...	...
	239	49.0	193	56.0	163.2	.....	...	...
	238	49.0	177	56.0	152.5	.....	...	...
	237	49.0	174	56.0	150.5	.....	...	...
	239	49.0	194	56.0	162.5	.....	...	...
	240	49.0	187	56.0	159.0	.....	...	...
Average test No. 6					163.2	100,400	7.0	66.9

Note: Due to heavy load, the observations showed more variation. All of above observations were taken at 5-minute intervals.

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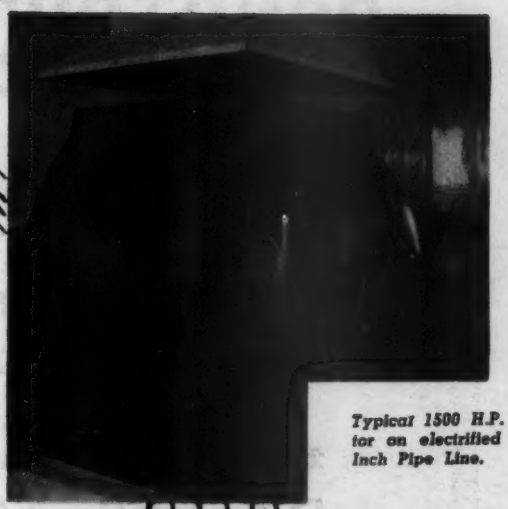
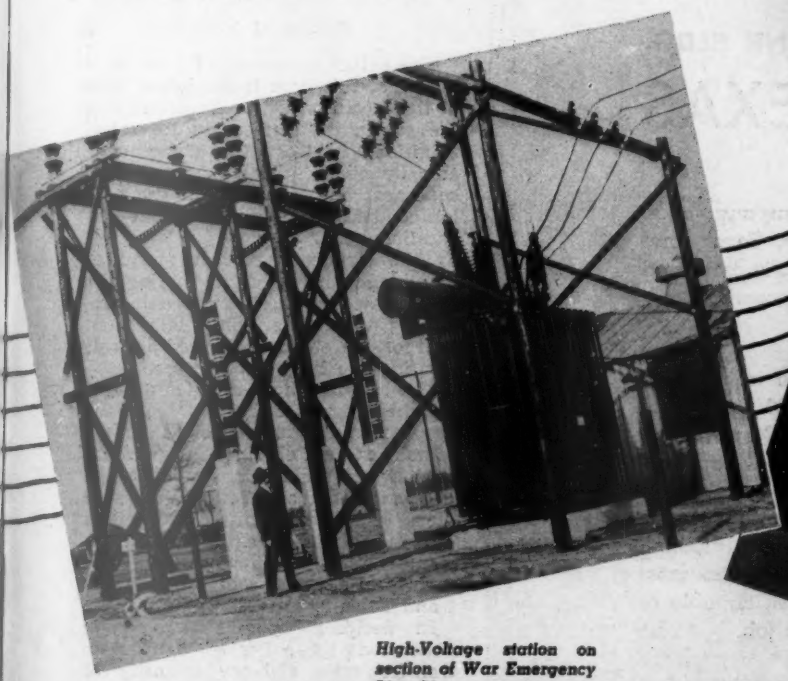


Typical 1500 H.P. motor on electrified Big-Inch Pipe Line.



High-Voltage station on section of War Emergency Pipe Line.

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This company is now engaged in construction of Section "U" of the 20 Inch War Emergency Pipeline project in New Jersey. Other projects are in stages of development.

Both management and manpower of this organization is fully competent in pipeline construction, and maintain only the most modern and efficient equipment capable of handling the toughest pipeline job.

The mass velocity, G, was calculated from the gas flow as follows:

$$G = \frac{Q \times W \times \text{sp. gr.}}{A} \qquad (3)$$

where

G = mass velocity, lb./hr./sq. ft. (cross-section)
Q = M.c.f. per hour at 16.4 lb. and 60° F.
W = 68.42 = weight of 1 M.c.f. air at 16.4 lb. and 60° F.
sp. gr. = .675 = specific gravity of flowing gas (air = 1.00)
A = 2.545 = cross-section area of pipe, sq. ft.

The mean temperature difference, M.T.D. was calculated from the following formula:

$$\text{M.T.D.} = \frac{(T_1 - t_2) - (T_2 - t_1)}{\log_e \dfrac{T_1 - t_2}{T_2 - t_1}} \qquad (4)$$

where

T_1 = inlet steam temperature
T_2 = outlet condensate temperature
t_1 = inlet gas temperature
t_2 = outlet gas temperature

This formula is based on the counterflow of gas and steam but due to difficulties in making connections this heater was designed for gas and steam flowing into the same direction or t_1 and t_2 were interchanged. This would have little effect on the heat-transfer efficiency because of the relatively small rise in gas temperature.

Source of Heat

The principal source of heat in a heater of this type is the latent heat of the steam which is transferred to the gas in the condensing to water. Additional heat could be made available by higher inlet steam pressure, superheat and reduction of the outlet condensate temperature but the additional heat gained is outweighed by the structural pressure requirements and difficulty of handling the condensate return. Therefore in designing this heater, only the latent heat of the steam was used in calculating the heat transfer area.

The required heat transfer area of this heater was calculated from the above formulas and checked against actual test data obtained in operation as shown in the accompanying tables. The calculated and actual values of the over-all heat transfer coefficient, U, checked within reasonable experimental limits as shown by a comparison of the last columns of Table 1 and Table 2.

In deciding upon the adequate dimensions for a heater required to transfer such a large quantity of heat, consideration was given to all possible adverse conditions of lower inlet gas temperature, lower steam pressure and other factors beyond control. No dependable data were

available for the design of such a heater and as precaution, the theoretical length was doubled and provision for flexibility incorporated in the design.

Design Calculations

Approximate temperature rise needed = 6° F.

Pounds per hour of gas = 280,000 lb. (115,000 M.c.f. per day at 16.4 lb.)

Assumed temperatures:
Inlet gas = 48° F.
Outlet gas = 54° F.
Inlet steam = 250° F.
Outlet steam = 200° F.

$$\text{M.T.D.} = \frac{(250 - 48) - (200 - 54)}{\log_e \frac{250 - 48}{200 - 54}}$$

$$= \frac{202 - 46}{2.3 \log_e \frac{202}{146}} = 173° \text{ F.}$$

Total heat input
= pounds per hour × specific heat × temperature rise
= 280,000 × .540 × 6 = 910,000 B.t.u. per hour

Transfer area and length of heater.

Assuming an over-all heat transfer coefficient of 65 B.t.u./hr./sq. ft.

$$A = \frac{\text{Total heat input}}{\text{M.T.D.} \times U}$$

$$= \frac{910{,}000}{173 \times 65} = 81 \text{ sq. ft.}$$

$$L = \frac{81}{3.1416 \times 1.8} = 14.3 \text{ ft.}$$

The primary purpose of this article is to suggest the validity of formulas (1) and (2) in calculating the required heat transfer surface of a gas line heater where linear gas velocities are of the magnitude usually found in natural-gas pipe lines. A study of the formulas indicates the major importance of the mass velocity and the gas film coefficient. The last two columns of Table 1 indicates the relative unimportance of the steel conductivity and steam heat transfer coefficient on the over-all coefficient. It should be noted that the over-all heat-transfer coefficient decreases rapidly with decreasing mass velocity but the required total heat transfer also decreases and the result is an approximate balance between these two factors within the limits set forth in this article. The reduction of the gas film coefficient with decrease in mass velocity is due to the gas film resistance or the "wiping action" of the gas velocity along the sides of the pipe.

National Pipe-Line Program Aids East Coast

(Continued from page 106)

The pipe-line program is now nearing completion. All but one of the projects are either completed or will be within a few months, the exception being the West Texas line which must wait until new pipe can be rolled during the fourth quarter of this year.

One other project has been approved by PAW, but as this was written it had not been given an allocation of materials by the War Production Board and so was not set up with a project number. This is an application of Magnolia Pipe Line Co. to build a new line between Corsicana, Tex., and Midland, Tex., consisting of 335 miles of 12-in. Two loops between Midland and Seminole, Tex., of 46 miles of 8-in. pipe, will be part of the project. The undertaking is estimated to cost $5,900,000, to carry 42,000 bbls. per day of West

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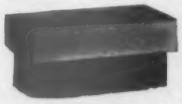

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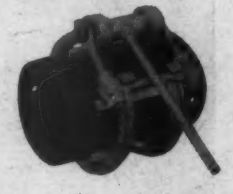

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Texas and New Mexico crude to Texas Gulf Coast refineries.

A number of other proposals have been made by the industry without securing approval, and one of them was recently rejected by PAW, a proposed products line from Albany, N. Y., eastward into Massachusetts. Construction of the new Magnolia line and addition of more pumping stations to the Stanolind line to increase its capacity to 116,000 bbl. per day would move about all presently available West Texas crude to Mid-Continent refineries. Some consideration is being given to new lines, or conversion of gas lines, to take crude from West Texas and New Mexico to refineries at Los Angeles, Calif., but such a major project is not likely to be undertaken during the next few months.

Two years ago, in August 1941, before Pearl Harbor, only 56,000 bbl. of oil per day, all of it crude, moved into District 1 by pipe line. The first gasoline came in during February 1942, when the original section of the Plantation line began operating. In August 1942 pipe lines moved 125,000 bbl. per day of both crude and products into District 1, but this alone does not tell the whole story because the network of pipe lines was moving increasing quantities of oil northward and eastward to shorten tank-car and barge movements.

By the middle of August 1943, just before the big-inch started deliveries, pipe lines were moving somewhat in excess of 200,000 bbl. per day of crude and products into District 1. Capacity operation of the big-inch, scheduled for mid-September, will increase deliveries by 300,000 bbl. per day and it is possible to step this line up somewhat higher in hot weather. The 20-in. products line should be delivering 165,000 bbl. per day to the East Coast by January 1, and when all pumping stations are installed, about April 1, 1944, it will reach its capacity of 235,000 bbl. per day.

This will make a total of 735,000 bbl. of petroleum per day, both crude and products, delivered by pipe line from Southwest and Mid-Continent producing areas to Atlantic Coast states, or more than 40 per cent prewar tanker deliveries. This figure however, is for all products lines operating on gasoline; their capacity is reduced about 20 per cent when operating on heating oil.

Cost of Program

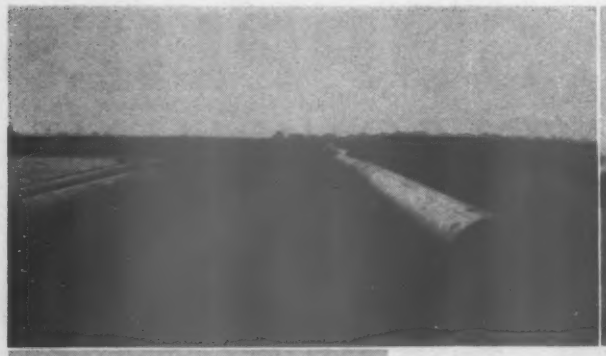
The total cost of this pipe-line program is estimated at approximately $250,000,000, including both government and private financing.

PAW recently made a compilation of the miles of pipe involved in projects it has approved, including not only these big projects but also allocations of new materials for short links and connections on other systems. As of July 1, 1943, these figures were as follows:

	Miles
New pipe:	
Crude lines	2,093
Products lines	2,125
Total	4,218
Second-hand pipe:	
Crude lines	1,218
Products lines	1,440
Total	2,658
Total construction	6,876
Existing pipe lines reversed or converted	3,303

In addition, PAW authorized the conversion of two natural-gas pipe lines to oil service, totaling 328 miles. These were the 177-mile Stanpac line in California, completed before PAW started designating "projects" by number, and the 151-mile Houston-Gulf gas line in Southwest Texas which is still in process of conversion.

The following descriptions of the individual projects summarize the most important facts about each to the extent that the information is available. The project numbers were assigned more or less arbitrarily by PAW, and do not always represent the order in which the projects were started. There are no projects numbered 7, 9, or 11, because these numbers were assigned to proposals which were later dropped for various rea-



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sons. Project 10, originally engineered separately, became part of Project 6.

Project 1.—A combination of existing lines to move crude from Texas Gulf and Mid-Continent areas to East Coast, involving 12 companies' reversal of two lines and the construction of 381 miles of 8, 10, and 12-in. loops and connections plus strengthening of several river crossings, and 11 new pumping stations plus additional equipment in many others. Privately financed; total cost roughly $5,000,000. Begun in the summer of 1942 and finally completed in February 1943, though the system was in partial operation in the fall of 1942. Now operating at capacity, moving 40,000 bbl. per day additional of crude to Illinois of which 27,000 bbl. per day reaches eastern refineries.

This is the most complicated of all the projects, and was the first attempt to make a through west-east trunk system out of lines of various companies running in opposite directions and built for different services. Project 1 was divided into three geographical parts.

Part A: Texas into Oklahoma. The 8-in. crude line of Texas Pipe Line Co. between Port Arthur and Dallas was reversed and its capacity increased by 18,000 bbl. per day by a new pump station at Waxahachie, Tex., and 69 miles of 10-in. and 43 miles of 8-in. second-hand pipe in loops between Dallas and Stuart, Okla. The Stanolind crude line increased its capacity by 10,000 bbl. per day by laying 54 miles of 12-in. loops of new pipe between Graford, Tex., and Healdton, Okla., and installing a new pump station at Devol, Okla. Oklahoma Pipe Line Co. built a 10-mile 8-in. line between Hewitt and Healdton, Okla.

Texas Empire Line

Part B: Oklahoma and Kansas to Illinois. The Texas Empire line between Cushing, Okla., and Chicago, installed 11 miles of loops at Valley Center, Kans.; a 32-mile loop of 12-in. second-hand pipe between Heyworth and Wilmington, Ill., and installed three new pump stations; thus increasing its capacity by 14,000 bbl. per day between Kansas and Sheldon, Mo., and by 30,000 bbl. per day between Sheldon and Heyworth, Ill. Stanolind installed superchargers at 10 of the 12 main-line stations in Missouri and Illinois to increase capacity 4,500 bbl. daily. Ajax laid 10 miles of loops while Shell and Stanolind replaced several river crossings to improve their Oklahoma - to - Illinois lines.

Part C: Illinois to East Coast. To move more crude across Ohio and connect with lines in Pennsylvania, Buckeye Pipe Line Co. increased its capacity between Mantua, Ohio, and Cooks Ferry, Pa., by 5,000 bbl. per day through installation of additional pumping equipment; and Illinois Pipe Line Co. laid 152 miles of new 8-in. pipe with a capacity of 15,000 bbl. per day paralleling its line between Lima and East Sparta, Ohio. In Pennsylvania Tuscarora Oil Co. reversed and converted to crude service its 360-mile gasoline line between Bayway, N. J., and Negley, Ohio, handling 20,000 bbl. per day, of which 15,000 bbl. per day is received at Negley from the pipe line of Ohio Oil Co. and 5,000 bbl. per day from the Buckeye system to Bears Creek, Pa., and via a section of the National Transit Pipe Line to Maharg, Pa. Additional crude from the Buckeye line goes through sections of the Northern Pipe Line via Bears Creek to Rixford, Pa., to a connection with the Tide Water Pipe Line which added two new pump stations and increased its capacity by about 2,000 bbl. per day to Bayway and Bayonne. The Southern Pipe Line through affiliated line was hooked into this system south of Mantua and Negley, Ohio, and increased its capacity across Pennsylvania 5,000 bbl. per day by the addition of two new pump stations. National Transit Co. looped about 10 miles of its line east of Millway, Pa.

Project 2.—Plantation line. An existing gasoline line was enlarged and extended at both ends, involving

seven private companies and a government corporation, 480 miles of new construction, and 25 new pumping stations. Begun in July 1942, and entirely completed in March 1943, it is now in use to capacity moving 90,000 bbl. per day of products from Gulf refineries to Bremen, Ga., 63,000 bbl. per day to Greensboro, N. C., and 30,000 bbl. per day beyond to Richmond, Va. The project was divided into three parts.

Part A: Bayou Pipe Line Co., formed by the Humble, Shell, Texas, Pan American, Pure, and Crown Central oil companies, built 68 miles of 8-in. line between Baytown and Port Neches, Tex., 185 miles of 10-in. line between Port Neches and Baton Rouge, La., and 51 miles of 4, 6 and 8-in. feeder lines to refineries in the Houston area, all of second-hand pipe, and 11 pump stations at a total cost of about $7,400,000, privately financed. This line delivers 60,000 bbl. per day of refined products to the Plantation line at Baton Rouge.

Part B: The Plantation line as originally built in 1941-42 had a capacity of 60,000 bbl. per day of gasoline between Baton Rouge, La., and Bremen, Ga., and 42,000 bbl. per day into Greensboro, N. C. The addition of 14 new booster stations involving some $4,000,000, privately financed, increased its capacity 30,000 bbl. per day.

Part C: Defense Plant Corp. at a cost of about $4,500,000 built 175 miles of 8-in. line of second-hand pipe from Greensboro to Richmond, Va. It is operated by the Plantation line as agent and in June 1943 reached its capacity of 30,000 bbl. per day. From bulk terminals at Richmond products are barged throughout the Hampton Roads and Chesapeake Bay region.

Ohio Emergency Line

Project 3. — Ohio Emergency line. By construction of 107 miles of 8-in., second-hand pipe, product lines from Illinois and Ohio were linked to an existing line from the East Coast to northeastern Ohio, which was reversed, making a through system for 15,000 bbl. per day of products eastward. Construction work started in November 1942 and was completed in January 1943.

An 82-mile 8-in. line with one pump station and capacity of 20,000 bbl. per day was built for Defense Plant Corp. by Ohio Emergency Pipe Lines, Inc., formed by Standard Oil Co. of Ohio, Sun, and Shell, running between Tiffin and Doyestown, near Akron, Ohio, at a cost of about $1,200,000. At Tiffin connection is made with a 14-mile spur from Fostoria, owned by Standard of Ohio and projecting from its Lima-to-Toledo line. From Doylestown to Randolph Standard built at its own expense a 29-mile extension to connect with the Sun-Susquehanna line between Philadelphia and Cleveland, which line, with a capacity of 15,000 bbl. per day, was reversed. About 5,000 bbl. per day of products are distributed in the Akron-Canton area. At Lima the Standard line is fed by the Shell line from Wood River, Ill. Additional gasoline enters the Shell system at Zionsville, Ill., from the line of Standard Oil Co. of Indiana from Whiting, Ind. To provide means of moving this gasoline to Lima, the capacity of the Shell line east of Zionsville was increased from 15,000 to 23,000 bbl. per day by constructing a new pump station at Muncie.

Project 4. — Reversal of two lines in Pennsylvania to move 25,000 bbl. per day of crude and 12,000 bbl. per day of products eastward from Ohio River barge and tank-car terminals. There are three parts to this project.

The Keystone 280-mile 8-in. gasoline pipe line of Atlantic Refining Co. from Philadelphia to Pittsburgh, Pa., was reversed and converted to crude in May 1942. It is now moving its capacity of 25,000 bbl. per day and is supplied by tank-car shipments from Norris City, Ill., and the Southwest, although it can also transship from river barges.

The Sinclair products line from Philadelphia to near Pittsburgh was extended to the Ohio River at Steu-

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benville, Ohio, by construction of 110 miles of new 6-in. pipe. A branch from Schaefferstown, Pa., southward to Baltimore was extended to Washington, D. C. That part of the line between Schaefferstown and Steubenville was reversed and is now moving eastward its capacity of 12,000 bbl. per day of products supplied by Ohio River barges. This line also pumps products westward from Philadelphia refinery to Schaefferstown, and thence south to Baltimore and Washington. This eastern leg could be reversed if necessary, but this apparently will not be done since present operations provide greater distribution.

Part of the Buffalo Pipe Line between Buffalo and Rochester, N. Y., was reversed to shorten the barge movement on the New York Barge Canal, and during the navigation season is capable of moving 9,000 bbl. per day of products eastward, supplied by lake tanker.

Project 5.—Helena line. Two lines between Port Arthur, Tex., and El Dorado, Ark., were reversed and a new line laid from El Dorado to Helena, Ark., 158 miles of 10-in., second-hand pipe, with four pump stations. Products are delivered to barges on the Mississippi River for movement north. The line has a capacity of 55,000 bbl. per day of gasoline or 50,000 bbl. per day of heating oil, and since its completion in December 1942 it has been running a combination of both. The new line was privately financed at a cost of about $3,700,000, and is operated by Project Five Pipe Line Co., formed by the Gulf, Socony-Vacuum, Texas, Premier, and Lion oil companies.

Gulf's 372-mile 8-in. crude line between El Dorado and Port Arthur was reversed and converted to products. Texas Co.'s 187-mile 8-in. products line between Shreveport, La., and Port Arthur was reversed, and a 15-mile extension of second-hand pipe was laid connecting it with the reversed Magnolia 8-in. line from Benton Junction to El Dorado, Ark., a distance of 74 miles. Magnolia also built a 7-mile extension from Beaumont to Port Neches, Tex., to tie in with the Texas line. The system eliminates 15 days of barge travel between Port Arthur and Helena. From Helena products are barged 1,290 miles to Pittsburgh, Pa., a 37-day trip.

"Little Big Inch"

Project 6 (and 10).—The 20-in. line or "Little Big Inch." A new line for products from Texas Gulf Coast refineries to New York Harbor, 20-in., 1,640 miles of new construction including feeder lines, all new pipe; 29 pump stations; capacity, 235,000 bbl. per day of gasoline (20 per cent less heating oil) Beaumont, Tex., to New York. Built by War Emergency Pipelines, Inc., for Defense Plant Corp. at an estimated cost of $75,000,000, government financed. First pipe was laid April 21, 1943, and final completion to full capacity estimated for April 1, 1944.

Project 6 was first authorized to extend from Beaumont, Tex., to a rail terminal, originally Seymour, Ind., now Norris City, Ill. Before it was completed Project 10 was authorized (March 23, 1943) to continue the line to Linden, N. J., as a single project. The western leg to Norris City, 835 miles, will be completed in September 1943 and is scheduled to start delivering some 100,000 bbl. per day by October 1, and increasing amounts during the fall. Full use will be made of existing tankage and railroad loading facilities at Norris City, built in connection with the 24-in. crude line but no longer required for transshipping products eastward by rail pending completion of the east leg. By January 1 the eastern leg is scheduled to be completed with half the ultimate number of stations in operation to deliver 165,000 bbl. per day to the East Coast, and by April 1, 1944, all pump stations are scheduled to be completed permitting delivery of full capacity of 235,000 bbl. per day. From Little Rock, Ark., eastward the line follows the right-of-way of the already completed "Big Inch" crude line. A 61-mile 16-in. connecting line extends from Baytown to Beaumont, and 60 miles of

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6, 8 and 10-in. feeder lines connect with refineries in the Baytown area and 51 miles of 6, 10 and 12-in. lines in the Beaumont area.

Project 8. — The "Big Inch." New line to take crude from Texas to New York and Philadelphia refining areas, 1,253 miles of 24-in. new pipe, 111 miles of 20-in. pipe, an extensive feeder system, and 26 pump stations. Capacity, 300,000 bbl. per day of crude, but tests have shown considerably above this in warm weather. Built for Defense Plant Corp. by War Emergency Pipelines, Inc., at estimated cost of $95,000,000, government financed.

The line was originally engineered from Longview, Tex., to Norris City, Ill., and later was extended to Phoenixville, Pa. Actual construction started August 3, 1942. First oil was loaded into tank cars at Norris City February 19, 1943. Same week construction started on eastern leg, which started operating middle of August delivering up to 150,000 bbl. per day generally to Philadelphia refineries. Full capacity of 300,000 bbl. per day of crude scheduled for mid-September. During construction of eastern leg oil was moved eastward by tank cars from Norris City and via a 6-mile 14-in. spur to Enfield, Ill., connecting with the pipe line of Ohio Oil Co. From Phoenixville 23 miles of 20-in. pipe leads to Chester Junction, Pa., and 88 miles of 20-in. pipe to Bayway, N. J.; from these two points various refineries are served by short 10, 12, 14, and 16-in. delivery lines. Line was originally intended to alternate movement of crude and heating oil but no heating oil has been moved through it and probably will not be. Instead at least three grades of crude, including West Texas sour oil, are being batched through the line.

To feed the Big Inch at Longview, WEP built 50 miles of short links of various sized pipe to handle different grades of crude, and four companies reversed their lines from the Gulf Coast at their own expense. These were the Sun-Stanolind from Beaumont, 195 miles of 10-in.; Pan American from Texas City, 224 miles of 12-in.; Shell from Houston, 194 miles of 10-in.; and Atlantic from Atreco, 184 miles of 10-in. Several other new projects in Texas also will either feed the Big Inch ultimately or will replace crude going into it.

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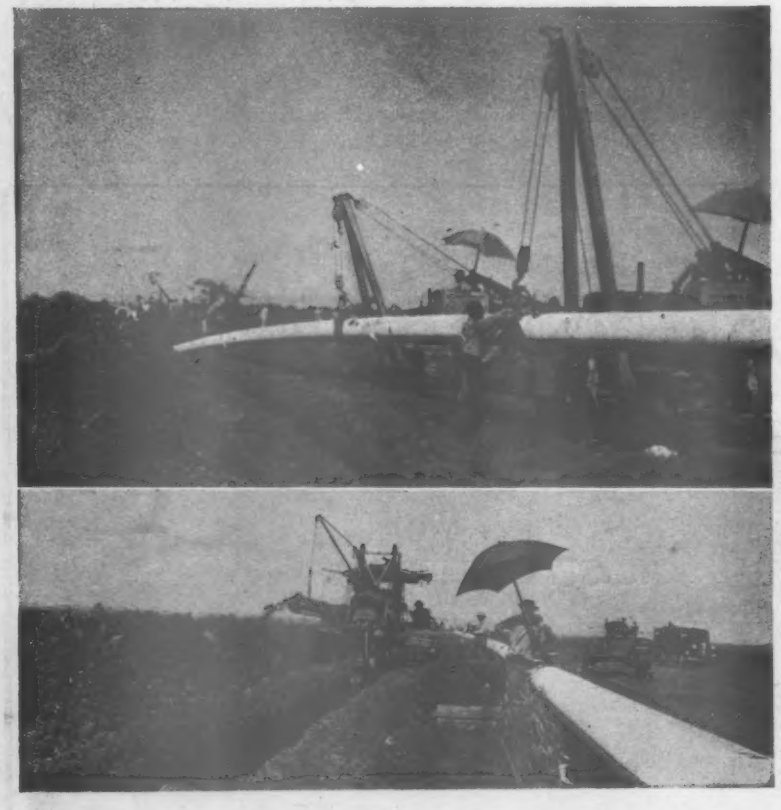
ON WAR EMERGENCY PIPE LINE

20" PRODUCTS LINE



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Florida Line

Project 12. — The Florida line. A new line to carry gasoline eastward across northern Florida to connect Gulf and Atlantic coastal waterways. Built by Trans-Florida Pipe Line Co. for Defense Plant Corp. at a cost of about $4,200,000, government financed, 199 miles of second-hand, 8-in. pipe, seven pumping stations, capacity 28,000 bbl. per day, completed in April 1943.

The old American Liberty Pipe Line in East Texas was dug up and relaid. Line is now operated for DPC by Florida Emergency Pipeline Co., formed by the Southeastern Pipe Line Co. which is jointly owned by Pure and Gulf oil companies. Barges bring gasoline from Texas to the terminal at Carrabelle on the Florida Gulf Coast. Line is currently pumping about 20,000 bbl. per day, the chief limiting factor being barge capacity on the Gulf Intra-Coastal Waterway. From the Jacksonville terminal gasoline is distributed by barge for local consumption in Florida and the Carolinas.

Project 13.—A new crude line from Corpus Christi to Damon Mound, Tex., 149 miles of second-hand 8-in. pipe, four pump stations, capacity 25,000 bbl. per day of crude, built by Sinclair Refining Co. at an estimated cost of over $3,000,000, privately financed, completed in May 1943 and now pumping to full capacity.

The purpose of this line is to supply Southwest Texas crude to the Houston refining area to replace crude diverted from East Texas to the Big Inch. At Damon Mound the new line connects with existing Sinclair line to Houston and beyond. Pipe was provided by taking up Sin-

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clair's line out of the Texas Panhandle.

Project 14. — Paradis line. A new line to carry both crude and distillates westward across Louisiana Gulf Coast from several fields to refinery at Port Arthur, Tex. Involves 266 miles of new construction, 120 miles of 8-in. and 146 miles of 10-in., all second-hand pipe, and 10 pumping stations. Capacity 40,000 to 45,000 bbl. per day. Built by Texas Pipe Line Co. at cost of around $5,500,000, privately financed. Put into partial use in February 1943 and completed in June.

This is the only one of the wartime projects not moving oil north or east. It was needed to bring special Louisiana crudes to the Texas refinery at Port Arthur for manufacture of butadiene and 100-octane gasoline. Now operating close to capacity entirely on crude, but later is expected to move some distillates.

Project 15. — A new line to feed gasoline from Deep Rock and through other Oklahoma refineries in the Cushing-Drumright area to Barnsdall, Okla., to connect with the Great Lakes Pipe Line System to Minneapolis and Chicago. Construction consisted of 51 miles of 6-in. main line and 14 miles of branch lines, all second-hand pipe, and a pump station at each of the four refineries. Capacity 10,000 bbl. per day of gasoline. Privately financed at a cost of about $1,000,000. Completed in March 1943 and in use at capacity since. Line was subsequently purchased by the Great Lakes company, which handles this additional gasoline by reason of eight new booster stations installed to increase capacity between Kansas City and Minneapolis.

Southwest Emergency Line

Project 16.—The Southwest Emergency line. Conversion of a natural-gas line to move crude and heating oil from the Corpus Christi producing and refining area to the Houston refining area in Texas. Project being constructed by Humble Pipe Line Co. for Defense Plant Corp., which is financing it at an estimated cost of $7,225,000. Completion estimated by October 15, 1943. Capacity 75,000 bbl. per day.

DPC purchased the 150-mile 14 and 16-in. line of Houston Gulf Gas Co. between Refugio and Pierce Junction, for $2,625,000, and allocated $2,000,000 for connections and four pump stations. Line was found unsuitable for oil and is now being dug up, cut, cleaned, reconditioned, welded and relayed, at estimated additional cost of $2,600,000. At the southern end a 3-mile, 12-in. extension was built and several crude lines between Corpus Christi and Refugio will be reversed to feed the line. At the northern end 26 miles of 12-in. pipe were laid from Pierce Junction to Houston, and 8 miles of 8-in. pipe to connect to the Shell refinery at Houston. New stations were built along the old gas line. When completed, it is expected 25,000 bbl. per day will be used by Houston refineries and 50,000 bbl. per day will be pumped north to the Big Inch at Longview.

Project 17.—Connecting link near Houston, Tex., to assist movement of crude to Illinois through other lines. Sinclair Refining Co. laid 29 miles of 12-in. second-hand pipe from Houston north to its Huffman station, and one pump station, at a cost of about $900,000, privately financed. Capacity 50,000 bbl. per day.

This link will carry part of the Corpus Christi crude reaching Houston via Projects 13 and 16 and destned for the Big Inch at Longview. At Huffman the link connects with Sinclair's 8-in. east-west line, which later will be reversed between Huffman and Smiths Bluff, where it will connect with the Atlantic 10-in. line going north to Longview. At present the link is moving about 16,000 bbl. per day of southwestern crude to Huffman and thence north through the Sinclair system via Hensley to Illinois.

Project 18.—A new crude line from Southern Louisiana to Baton Rouge, 109 miles of 6, 8 and 10-in. main line and 24 miles of 4 and 6-in. feeder lines, all second-hand pipe. Capacity 15,000 bbl. per day delivered to Baton

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Rouge. Built by Standard Oil Co. of Louisiana at a cost of approximately $1,500,000, privately financed. Main line is completed and in operation, and feeder lines are scheduled for completion during September.

Starting at the Golden Meadows field near the Gulf, the line goes northwest through Valentine and Raceland fields to Choctaw field, then north to Baton Rouge refinery. Feeders will connect the Delta Farms and Bayou Allemand fields. These fields were formerly served by barges which are now relieved for other service.

Project 19.—Enlargement of Stanolind Pipe Line No. 2 system from Texas to northern Oklahoma. Stanolind built 139 miles of new lines in seven loops of 8 and 10-in. pipe, all second hand, between Mexia, Tex., and Pauls Valley, Okla., to increase the capacity of this line ultimately by 20,000 bbl. per day.

The Stanolind line from Texas

(Continued on page 238)

Machine Cleans Pipe With Steel Grit

PIPE is cleaned with equipment for the application of steel grit by mechanical pressure in the program of Pipe Line Service Corp. Accompanying photographs show operation of the first of these machines installed at the company's Corpus Christi, Tex., plant. By this method, used pipe can be cleaned at the rate of 5 to 50 ft. per day depending on the diameter and condition of the pipe. Efficient cleaning of pipe is assuming more importance in wartime when the industry must rely to a larger extent on supplies of pipe reclaimed in salvage undertakings in order to have material for laying new lines to meet emergency conditions.

Subsequently this machine has been moved from Corpus Christi to reconditioning operations carried on at a yard near Livingston, Tex., where 10-in. pipe of Shell Pipe Line Corp.'s line from the Gulf Coast to East Texas is being overhauled. The program is planned so that the line can be almost continuously in service for moving crude oil to feed the War Emergency Pipelines, Inc., 24-in. line, while repair work is conducted on 20-mile sections of 85 miles of line. Pipe is removed from the line and brought to a yard. Following grit-cleaning machine operations, pipe is spot-welded, coated and wrapped before it is laid in the line again. The grit-cleaning machine is soon to be moved to Corrigan, Tex.

Left: Grit-cleaning machine
Below, left: Pipe entering machine
Below, right: Pipe after cleaning

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(Continued from page 236)

across Oklahoma and on to Chicago is also part of Project 1. Between Mexia, Tex., and Humboldt, Kans., loops were completed in April 1943 and since then the capacity of this portion of the line has been increased by 10,000 bbl. per day. When additional pumps are installed in several stations during October this line will handle an additional 10,000 bbl. per day, part of it probably West Texas crude received at Ranger from the Humble line.

Project 20.—New line to carry products across northern Indiana and Ohio. Sinclair Refining Co. is building 250 miles of 8-in. line, using second-hand pipe, from its East Chicago refinery to an extensive new terminal at Toledo, with seven intermediate pump stations. Capacity 30,000 bbl. per day, privately financed, estimated cost about $6,000,000. Construction now under way and completion scheduled for October.

The line will assist the general eastward movement of products by eliminating the long lake tanker haul from Chicago to Toledo. Products will be consumed in the Toledo area and transshipped eastward by tank car and during navigation season by lake tanker and barge.

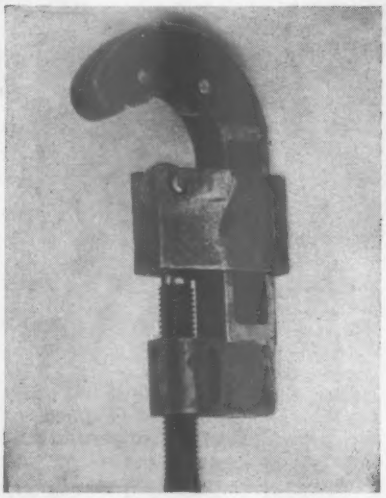
Project 21.—The West Texas line. A new line to take crude from the Slaughter field in Hockley County, West Texas, to Drumright, Okla. Involves laying 385 miles of new 16-in. pipe and building two pump stations. Capacity 65,000 bbl. per day. To be built by Stanolind Pipe Line Co., privately financed, at estimated cost of over $4,000,000.

This line has been authorized but production of the pipe cannot begin until the fourth quarter of this year. Completion expected in March 1944. Line will tap West Texas now lacking transportation outlet and will provide additional crude to refineries in the Chicago area through existing pipe lines running north out of Oklahoma. Survey is completed, right-of-way is being acquired and orders have been placed for pumping equipment.

Knurling Tool Has Numerous Uses

A tool developed by Emile Van DePutte of the San Francisco transportation department of Pacific Gas & Electric Co. is constructed by removing the cutting wheels of a standard pipe cutter and replacing them with knurling wheels. The knurling tool was awarded a special prize in the 1942 Employe Suggestion Contest sponsored by the company's research committee.

This device is useful in rehabilitating worn automotive or other mechanical parts. It has been successfully used to knurl ball and roller-bearing shafts to increase effective diameter shaft; knurl front spindles, transmission, rear axle and pinion shafts; generator, starter and starter drive shafts; winch and compressor drive shafts. Worn bronze bushings have been successfully repaired, when not too badly worn, by mounting bushing on expanding mandrel or reamer and knurling outside surface. Bushing can then be reamed to original size. This tool eliminates the necessity of using a lathe.



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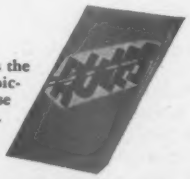

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Weighting Acid With Calcium Chloride Aids in Freeing Stuck Tools

by Harry F. Simons

When using hydrochloric acid to free tools stuck in a well being drilled it is necessary that the acid have approximately the same, or in many instances a greater, specific gravity than the drilling fluid. Calcium chloride may be used as a weighting agent in the acid to a maximum of 4 lb. per gal. to produce a solution weighing 12 lb. per gal. Use of this treatment to free a fish in a North Central Texas well is described.

THE use of hydrochloric acid as an aid in freeing stuck drilling bits and tools antedates its use as an oil-production stimulator or increaser. It was not common practice however until the service for acidizing productive formations (principally limestones) was developed but since that time it has been widely applied. At the present time in rotary drilling practice, and to a lesser extent in cable-tool drilling, it is almost the first remedy which comes to mind, particularly when the bit is stuck in a limestone or a dolomite formation. The effectiveness of the method and the chemical reaction involved are well known.

One of the problems involved in freeing stuck tools, that of placement of the acid and retention at the point desired, is illustrated by a well being deepened in a Wichita County, Texas, field. The well had been producing from Ellenburger and was being deepened through limestone formations in search of a porous zone to be used for water disposal. Several hundred feet of new hole was drilled when a fishing job developed. Because of the conditions present the acid used to free the stuck fish was weighted with calcium chloride.

The use of calcium chloride as a weighting agent, or blanket, is not new, although it has not been widely used by the drilling industry as yet. Its purpose is to aid in putting the acid where it is needed and holding it there in spite of the conditions, particularly the density of the mud or drilling fluid, in the hole.

When two fluids of unlike density are placed in a tube, the lighter one will come to the top and the heavier will sink to the bottom. If the lighter fluid is placed on the bottom of the tube, as with a pipette, it will rise, the rate of movement being dependent on the viscosities of the fluids and the difference in densities. This same effect takes place when acid is placed around a bit or tools stuck in a bore hole where the density of the mud or drilling fluid is rarely the same as that of the acid; generally the drilling fluid is considerably heavier.

When treating a formation with acid to free drill pipe stuck off bottom, and where circulation can be established through the bit, it is desirable that the acid solution have approximately the same density as the drilling fluid. After the acid is placed around the bit and the stuck portion of the drill stem it stays there until it is desired to move it.

It is often found that a fish resting on bottom is stuck after it has been caught with an overshot or a tapered tap. The latter tool, having no packing element will not permit a high pressure to be applied to force fluid down through the fish and up around it; sometimes due to conditions at the top of the fish where the grip is established with the overshot, the packing element will not hold. In either case it is impossible to get the acid needed for freeing the fish down around it unless the acid has a greater density than the drilling fluid.

Use of Acid With Cable Tools

A similar condition prevails when cable tools are stuck as the hole to the top of the tools is filled with heavy mud and there is no way of removing it. If the acid is to function as a freeing agent, it will travel downward through the mud so that it can contact the formation in which the tools are stuck.

The 15 per cent by weight acid normally used for freeing stuck drill

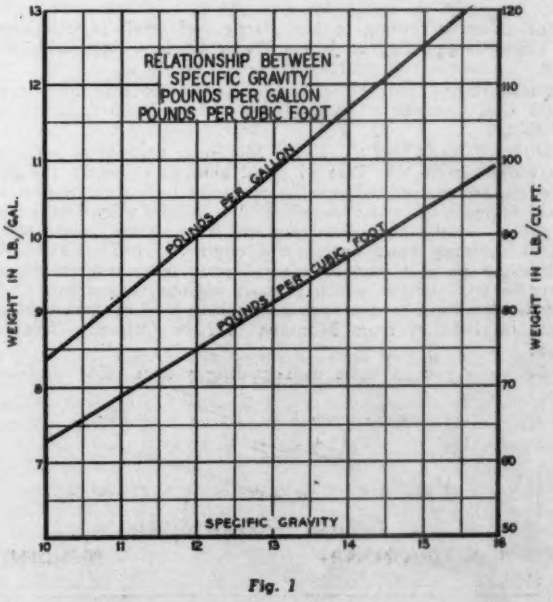
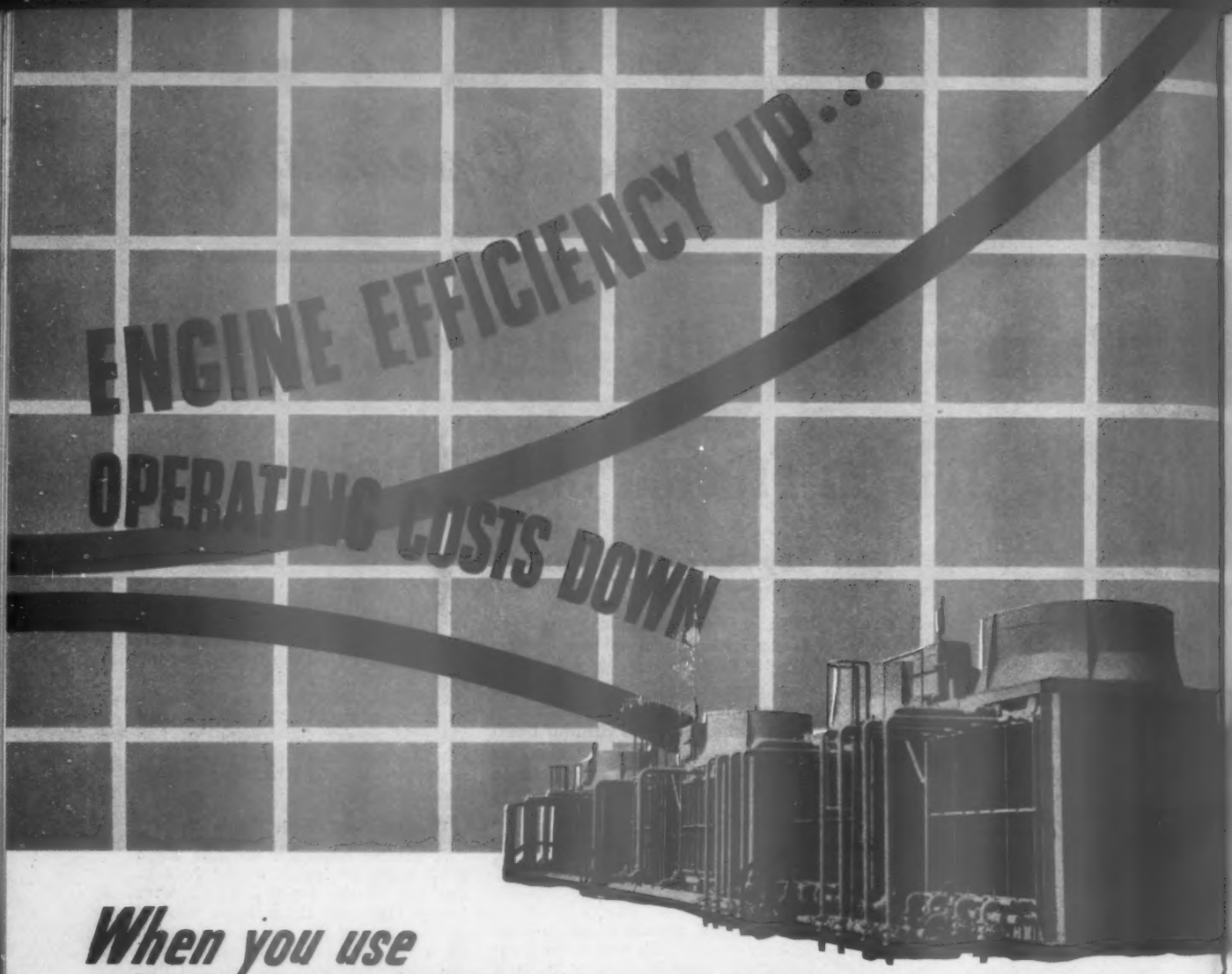


Fig. 1



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Acidizing crew at work

pipe has a specific gravity of 1.075 and a density of 8.95 lb. per gallon. The fluid in the hole may have a specific gravity anywhere from 1 to 1.5 or a density of 8.75 to 12.5 per gallon. More generally it will range from a specific gravity of 1.14 to 1.26 or 9.5 to 10.5 lb. per gal. Fig. 1 is a chart showing the relationship between density (lb. per gal. and lb. per cu. ft.) and specific gravity of fluids.

Increasing the strength of the acid would provide only a slight increase in its density and even if the required specific gravity could be obtained in this manner there are a number of reasons for not doing so. Consequently some inert material soluble in water and hydrochloric acid must be added to the acid solution to provide the proper specific gravity. Calcium chloride being inert, soluble and having a high specific gravity has been used for a weighting agent. It has no effect on the action of the acid or of the inhibitor used in it. With calcium chloride it is possible to obtain an acid solution weighing 12 lb. per gallon or a specific gravity of 1.44.

Saturation Point

Approximately 4 lb. of calcium chloride per gallon of acid solution is the maximum which can be added as at that point saturation is reached. This produces an acid solution with a density of 12 lb. per gallon and this is what is used when it is necessary for the acid to sink through heavy mud around a stuck portion of the drill stem.

On the well in North Central Texas, mentioned above, salt water was being used for a circulating fluid while deepening the well. This salt water had been stored in an open pit for a considerable time and was highly concentrated, being more like dead-sea water than ordinary formation-produced brine. Its density was approximately 10 lb. per gal. Having a very low viscosity, the movement upward of the acid due to differences in specific gravity would be quite rapid.

The fishing job was such that it was necessary for the acid to travel downward from the lowest point to which it could be pumped. Two-inch tubing was being used for a drill stem in a 4½-in. hole below 5½-in. casing and had twisted off approximately 200 ft. off bottom. The twist-off was not a clean circumferential break but a sliver was left projecting upward. Due to the diameter of the hole and drill stem it was impossible to use an overshot so fishing was practically limited to tools which could grip the inside of the fish, such as a tapered tap or a spear.

The fish was found to be stuck after it was caught with a tapered tap (Fig. 2) and an acid treatment was relied on to free it. This consisted of 2,000 gal. of acid to which 6,000 lb. of commercial calcium chloride had been added. This gives a solution slightly over 10.5 lb. per gal. The acid was placed in the usual manner through tubing, 3 hours being required. It was then allowed to settle to the bottom of the hole where it could attack the formation holding the bit. The fish was freed but due to the poor grip of the fishing tool it dropped back to bottom after being lifted up the hole. After contacting the fish again it was found to be stuck, was acidized loose a second time with an identical acid treatment as before, and dropped back when a tight spot was encountered up the hole. Because the poor grip which could be obtained and the tight hole above, it was decided that it would be quicker to sidetrack than to recover the fish. The weighted acid had accomplished the purpose for which it was placed in the well in both instances.

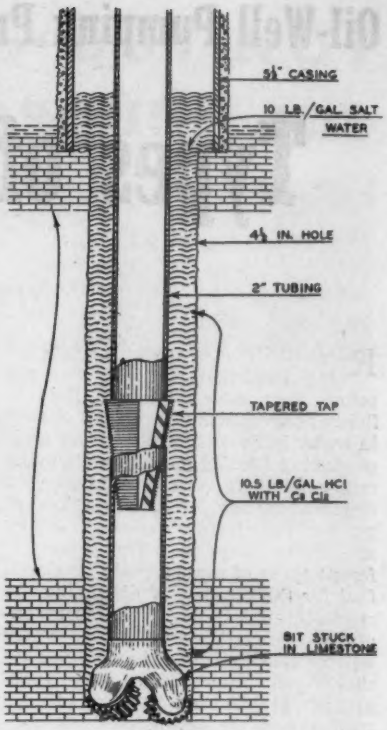

Fig. 2

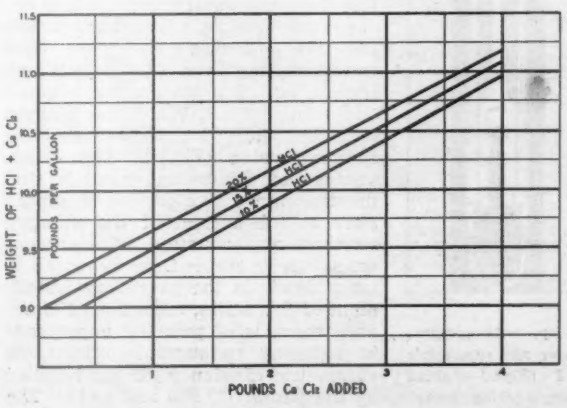

Fig. 3

Weighting the Acid

The weighting of the acid can be done in the field or at the acid depot. The dry calcium chloride in the desired amount is slowly added to the acid while the solution is agitated with compressed air. Amounts of calcium chloride to obtain the desired density with various concentrations of acid are shown in Fig. 3.

In addition to being used with acid for freeing stuck drilling tools, the calcium chloride is used in a similar manner to free casing pumps frozen in the hole due to precipitation of calcium carbonate. The treatment is the same as that for freeing stuck cable tools, the mixture of acid and calcium chloride being placed on the top of the casing pump with a dump bailer and allowed to settle down around the pump. A dilute acid in place of the customary 15 per cent or stronger is used for this type work.

Oil-Well Pumping Practices—No. 13

Types of Sucker-Rod Pumps

by J. Zaba

This installment of The Oil and Gas Journal's comprehensive series on modern oil-well pumping equipment and methods discusses the different types of sucker-rod pumps. The series began in the issue of July 1.

REQUIREMENTS imposed by pumping conditions on a sucker-rod pump, vary not only from field to field and from well to well but change in many individual wells during their producing life. To meet those varying requirements, a very large number of different types of construction of pumps has been developed. There are several ways in which these different types of pumps could be classified for the purpose of discussing the representative types. The most generally accepted classification, which will be followed here, is to divide all sucker-rod pumps into three large groups: (1) Tubing pumps, (2) rod pumps, and (3) casing pumps.

Tubing pumps.—To this group belong all pumps with the working barrel an integral part of the tubing. The barrel is installed on the bottom of the tubing string and is run into the well on the string, with plunger assembly lowered into the barrel on rods. This type of pump is characterized by simplicity of construction, has advantage of making possible use of larger-diameter plunger for given size of tubing, but requires pulling of tubing in order to service the barrel.

To make possible an orderly discussion of different types of tubing pumps, they are described here from three points of view: (1) In relation to the type of working barrel used, (2) in relation to the standing valve arrangement, (3) in relation to the type of plunger used. It is obvious of course that number of different combinations among the different types of these three classifications is possible. For instance a pump with certain type of working barrel may employ, with few exceptions, any one of different possible standing valve arrangements or any one of different types of plungers.

From the standpoint of type of working barrel used the tubing pumps can be subdivided into three groups: (1) Common working barrel pumps. The barrel is made out of cold drawn seamless steel, cast iron or corrosion-resisting alloys. Schematic sketch of common working barrel tubing pump is shown in Fig. 1. (2) Pumps using the so-called full-liner working barrel. Such a pump consists of a steel jacket with one-piece, cast iron or corrosion-resisting alloy, liner. (3) The so-called sectional liner tubing pumps. The barrel of such a pump consists of outside steel jacket with short machined liners placed end to end inside of the jacket. The liners are held in place by the collars of the jacket and are aligned by means of a close-fitting mandrel which is inserted into the barrel before the collars are wrench tightened. Free removal of the mandrel, after the collars are tightened, indicates satisfactory alignment of the liners. Some liners are provided with threaded connections. The liners are made of cast iron, hard steel, and alloy steels. A sectional liner pump is shown in Fig. 2.

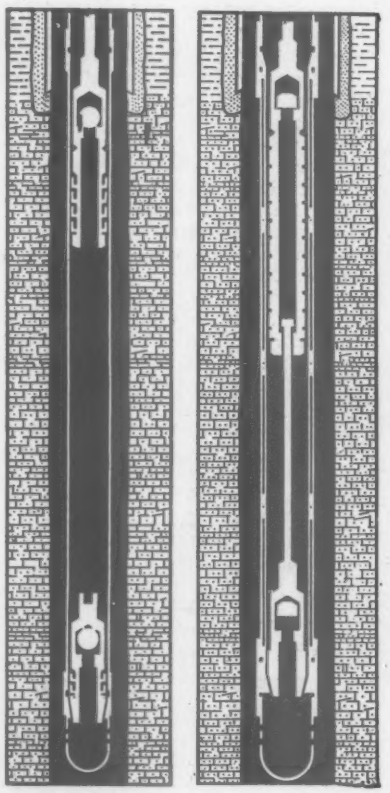

Fig. 1 (Left)—Tubing pump, with common working barrel, cup plunger and removable standing valve. Fig. 2 (Right)—Tubing pump, with sectional liner working barrel, grooved metal plunger and garbutt rod

From the standpoint of standing valve arrangement, the tubing pumps may have a fixed or a removable standing valve. As the name implies, in the fixed-valve type, the valve is attached to the tubing and pulling of valve for servicing requires a tubing roundtrip. (Fig. 3.) The removable standing valve is either placed in the working barrel before the barrel is run or is dropped down the tubing and pushed in place by the plunger. The valve is kept in place by one of several types of anchoring arrangements, such as seating cups, which release when pull with rods is applied. The valve may be removed either by making a second trip with the rods after the plunger has been pulled or it may be pulled out together with plunger. In the first case a tap may be run to engage in the threaded socket of the valve (Fig. 1). In the second case any of the number of available devices may be used to pull the valve with the plunger in one trip. Of these devices, the following are quite frequently used: (1) The J-tool, on the lower end of the plunger. The plunger is lowered and turned to right which motion engages the standing valve. The plunger and the standing valve are then pulled out together. (2) Garbutt rod. During pumping motion the plunger slides on the rod. When the plunger is pulled the rod pulls out also the standing valve (Fig. 2). The disadvantage of this arrangement is that the traveling valve cannot be placed close to the bottom of the plunger, so that no reduction of clearance space can be secured. As discussed in more detail in the preceding installment of this series, reduction of clearance space is of primary importance in reducing unfavorable effects, on volumetric efficiency, of gas handled by the pump. (3) Pin and socket. The plunger is lowered and turned to

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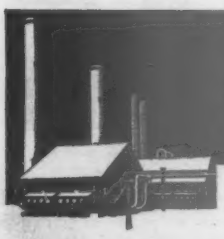

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right to engage the pin into socket and provide fixed connection between plunger and standing valve.

From the standpoint of type of plunger used, the most convenient method of classification would be to divide the tubing pumps into groups according to the type of plunger seal used. Under this classification the tubing pumps can be divided into following groups: (1) This group includes pumps with cup equipped plungers. The cups are made out of leather or rubber impregnated canvas and they represent the oldest form of providing plunger seal for oil-well sucker-rod pump (Fig. 1). (2) To the second group belong the pumps with metal plungers. The metal plunger depends on an extremely close clearance to provide the fluid seal. Some of the plungers are grooved to provide better lubrication and to create turbulent flow. Since the turbulence impedes the passage of fluid such arrangement may be needed in many cases to offset the looser fit used to compensate for difference in expansion of plunger and barrel (Fig. 2). (3) To the third group belong pumps which depend on both the fluid seal and an unusually long distance, the fluid would have to travel in order to slip past the plunger, to secure proper plunger seal. In this arrangement two concentric tubes with inside tube acting as a plunger slide, during the pump-

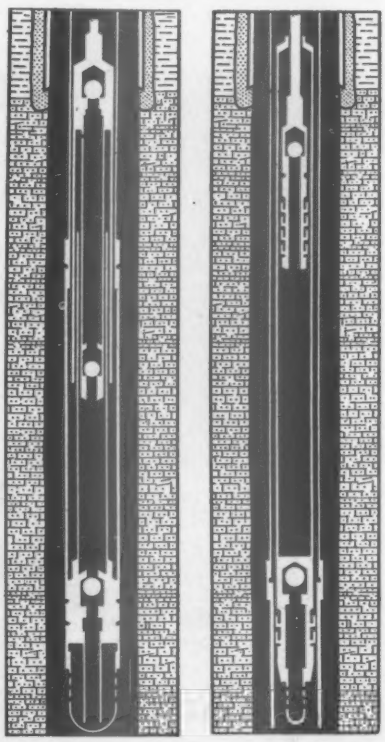


Fig. 3 (Left)—Tubing pump with concentric tubes and fixed standing valve. Fig. 4 (Right)—Insert pump with seating cups forced into old working barrel

ing motion, over the third, stationary, tube. To slip past the plunger, the fluid would have to first travel upwards between the outside traveling tube and the standing tube and then downwards between the stationary tube and inside traveling tube (Fig. 3). This great length of fluid seal eliminates necessity of a very close plunger fit.

Rod pumps.—To this group belong the pumps, quite often referred to as insert pumps, in which the plunger assembly and the barrel form a unit, assembled on the surface and lowered into the well on rods, as a unit. The rod pumps have an obvious advantage of reducing the time needed for servicing any of the parts of the pump. Another advantage is the fact that the highly machined working parts of the pump are protected during process of installation, since the pump is lowered into the tubing as a unit. For a given size of tubing the plunger diameter of a rod pump is smaller, however, than that of a tubing pump. Under heavy sand conditions, settling of sand between barrel and tubing may be a cause of considerable difficulties.

Inasmuch as the barrel is lowered on rods, means must be provided to secure the barrel in the bottom of tubing to provide fluid packoff and to make possible relative motion of barrel and plunger. Several arrangements are used for this purpose. Seating cups on bottom (or top) of the barrel when forced into old working barrel in place by friction (Fig. 4). Instead of old working barrel, special seating housing may be provided on bottom of tubing. Holddown anchors may be used with the holddown body's leaf springs forced into the holddown shoe. The anchor may be located at the bottom or at the top of the barrel. In the latter case, the entire pump passes through the shoe before seating and locking. The seal provided by such a top anchor minimizes the difficulties resulting from sand settling between barrel and tubing.

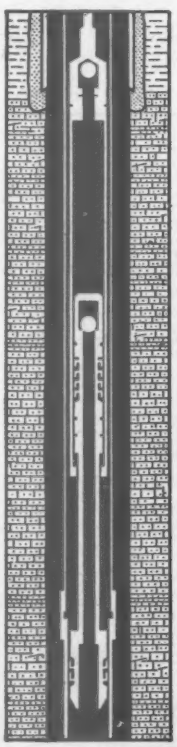


Fig. 5—Inverted insert pump

From standpoint of operation rod pumps are divided into two groups: (1) Inverted pumps (traveling pumps) in which the plunger assembly is stationary and the barrel is the moving part (Fig. 5). The moving barrel gives the sand less chance to settle between the barrel and tubing. On the other hand, the traveling valve of such a pump is larger than the standing valve, which is not a satisfactory arrangement, and the frictional wear is considerable. (2) The stationary insert pumps in which the barrel is stationary and plunger the moving part (Fig. 4).

From the standpoint of working barrel and plungers used most of considerations given on tubing pumps apply also to rod pumps. Concentric tube design pumps are available also in insert type.

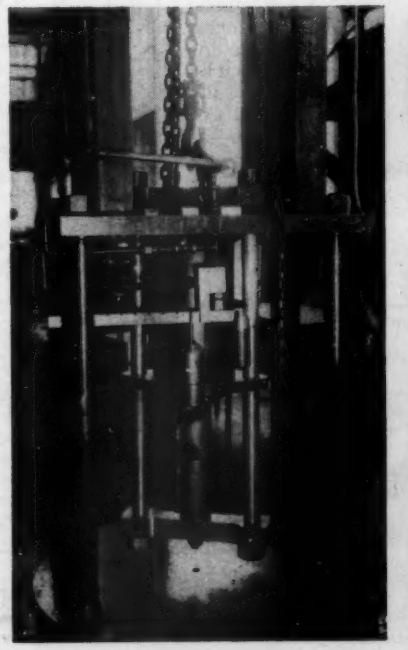
Casing pumps.—This group includes all pumps which use casing instead of tubing, as an eductor tube through which fluid is pumped up to the surface.

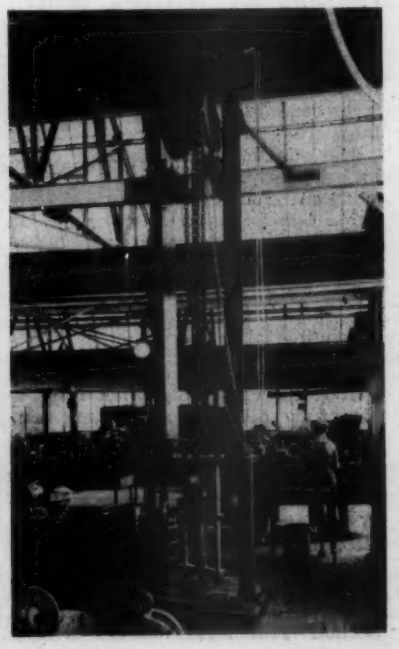
A casing pump is run into the well on sucker rods. Packer, on top or bottom of the barrel, provides the fluid packoff between barrel and casing, at any desired point of setting. The problem of support needed for expansion of the packer may be solved by one of several possible methods, either by special anchoring device, or by setting on liner, or by extending the gas and mud anchor to the bottom of the well. No tubing is used. As most generally used now the casing pump is a large volume pump.

Chain Block Tester From Old Press

THIS chain block tester handles blocks up to 10-ton capacity. The frame was originally a hydraulic press. A 2½-in. plate is at the bottom, and a large cross bar at the top to which the blocks are attached. The cylinder below is inverted, and the piston fitted with a yoke to pull against the blocks when moving downward. The pressure-control lever is fitted with a weight and notches at 1-ton intervals.

In operation, the upper hook of the block is placed over the upper bar, the lower or power hook attached to the yoke, the cylinder is full of oil, the arm weight set at the desired value, 1 or more tons. The operator pulls on the small chain operating the block against the hydraulic cylinder, until the pressure on the oil overbalances the weight arm, when the outlet valve opens. The power chain is operated until all the oil is forced out of the cylinder into the reservoir, and so tests the block in a lift position. For a lowering test the valve to the sump or reservoir is closed, and air pressure is admitted to the cylinder, maintaining approximately a 2½-ton load until the piston reaches the bottom of its travel against the set pull of the block. This is considered sufficient for a lowering test. This completes the test, and the oil valve is opened and air released while oil is admitted to the cylinder for the next test.





QUESTIONS on TECHNOLOGY

by W. L. Nelson

What Are "Sour" Crude Oils?

What is the distinguishing thing which makes us call a crude oil "sour"?—Z. I. W.

The term "sour" as applied to crude oils is by no means a definite one. It is used as a general or generic term to designate those crude oils which contain a sufficient amount (and kind) of sulfur to cause difficulty with corrosion and difficulty with sourness of the distillates produced from it by simple distillation.

The word "sour," as applied to distillate materials, such as gasoline, naphthas and kerosene, is far more definite in its meaning. It refers to materials that exhibit a positive test by the doctor test. For practical purposes a negative doctor test means that the distillate contains only traces of mercaptan sulfur compounds or hydrogen sulfide, and hence a "sweet" distillate infers one that contains substantially no mercaptan sulfur.

The same usage cannot be applied to crude oils because the gasoline and kerosene from almost any of them will contain enough mercaptan sulfur to show sourness by the doctor test. This applies to almost all straightrun light distillates, regardless of their source, even if they are derived from crude oils that contain scarcely any sulfur. Finally, cracked distillates always exhibit some degree of sourness regardless of the crude oil from which they are derived.

The stigma of describing a crude oil as "sour" is so vital that this department cannot attempt to classify crude oils by name with respect to sourness. It must also be recognized that a refiner who regularly processes a very low sulfur crude oil (say under 0.15 per cent) would refer to a proffered 0.3 per cent sulfur crude oil as a "sour" crude, whereas a refiner that was accustomed to handling a 0.35 per cent sulfur crude might not refer to his crude oil as "sour." Generally, such crude oils as those of West Texas, Smackover (Arkansas) and Oregon Basin have been referred to as "sour." All of these are very high in sulfur—so much sulfur that no one denies or disparages difficulties with sulfur.

Inasmuch as the term "sour" has no specific meaning, it would be wise to avoid the use of the term in connection with legal matters or any statements except most general ones, because it might be misleading to stamp a crude oil as "sour" and thus confer upon it a set of properties that are far worse than those actually possessed by the oil.

Latent Heats of Petroleum Fractions

I have looked in your book and elsewhere for latent heats and the methods are too complicated for me. Can you suggest some better source of information?—J. P.

Latent heat is an exceedingly complicated property, one which has for years been troublesome to engineers and designers. Even now, no simple methods of correlating or presenting them has been devised. Nevertheless, two typical stocks have been studied by the method of Watson (Ind. Eng. Chem. Vol. 23, p. 360, 1931) and their latent heats are shown as a function of temperature and gravity in the figure on this page. To make the information complete, it would be necessary to also compute and plot the data for paraffin base and naphthene base stocks. Even then, the information would not be entirely suitable because oils of every variety, as well as the typically paraffin, naphthenic, etc., bases are prevalent. The Watson correlation is probably the most accurate method now available, but it must be pointed out that experimental data are, at present, not entirely adequate.

The figure on this page shows approximate latent heats for cracked stocks (lower and right scales) and for mixed base stocks (lower and left scales). The black points indicate the latent heat at atmospheric pressure and in each instance the temperature at which the latent heat is zero is the critical temperature. The apparent inconsistency among some of the curves is due, in part, to the fact that different characterization factors were used for oils of different gravity. Thus, the characterization factors were:

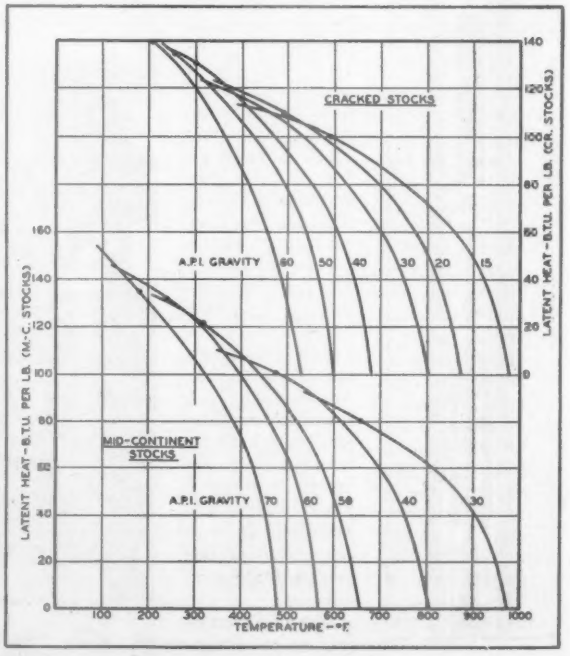
CRACKED STOCKS

A.P.I.	Characterization factors
60	11.8
50	11.5
40	11.2
30	11.0
20	10.6
15	10.5

MID-CONTINENT

A.P.I.	Characterization factors
70	12.3
60	12.0
50	11.8
40	11.8
30	11.8

It was thought that these characterization factors are representative of these stocks.


CRACKED STOCKS
A.P.I. GRAVITY 60 50 40 30 20 15
MID-CONTINENT STOCKS
A.P.I. GRAVITY 70 60 50 40 30
LATENT HEAT - B.T.U. PER LB. (M-C. STOCKS)
LATENT HEAT - B.T.U. PER LB. (CR. STOCKS)
TEMPERATURE - °F
0 20 40 60 80 100 120 140 160
0 20 40 60 80 100 120 140
100 200 300 400 500 600 700 800 900 1000

Approximate latent heats (black points are values at atmospheric boiling point)

PRODUCTION RATES AND PROFITS

A COST analysis showing profit or loss and payout period on any remedial work to increase production is essential. Such an analysis may take the form of an estimate at the time the work is recommended or it may be a detailed statement of profit or loss at some date after the work is completed and information is available.

Reconditioning work such as clean out and acidizing are usually considered only on the basis of short time payout periods, since the benefits realized from such jobs may be obscured over any great period of time. A new problem arises, however, when the production rate is increased substantially over a period of several years. New equipment, capable of greater rates of withdrawal, may be installed and the oil is recovered in a shorter period of time.

Such an example is shown in the accompanying figure. New equipment was installed at this well January 1, 1938, to increase the withdrawal rate and the oil was obtained in 2 years less time than was indicated by the production trend previous to 1938. Production decline curves both before and after the installation of new equipment are shown, the trend previous to 1938 being extrapolated for purposes of comparison.

Profit—Two Withdrawal Rates

A cost comparison showing the increased profit realized from the faster rate of withdrawal is shown in Tables 1 and 2. In order to have some method of comparison, the analysis has been based on the amount of profit (for both the slow and fast withdrawal rates) which would have been accumulated on January 1, 1944, where expenses, interest and other pertinent factors have been taken into consideration.

Referring to Table 1, Part A, the gross production by years, which the well would have made from 1938 to 1943, inclusive, if the slow withdrawal rate had been continued, has been estimated. The second column showing barrels of net oil per year is the gross oil production less one-eighth royalty. The value of the net production by years was calculated on the basis of $1.10 per barrel of oil. The estimated operating and repair expense (based on records prior to 1938) then was subtracted from the value of the net oil. State gross production taxes also should be deducted from the value of the net oil if the well is located in a state where these apply.

The column headed "yearly net profit" shows the profit over and above operations for each year. Since this money may be invested in further operations for profit, interest at the rate of 5 per cent compounded annually to January 1, 1944, has been added to the net profit by years. Thus the last column shows the total profit from operations which would be accumulated on January 1, 1944.

Part B, Table 1, has been computed in the same manner with the exception that all figures are actual data from operations. A comparison of the profit realized by the fast withdrawal rate with the estimated profit which would have been accumulated if slower pumping had been continued is shown in Table 2. It is noted that the faster withdrawal rate gave an additional profit of $6,161.

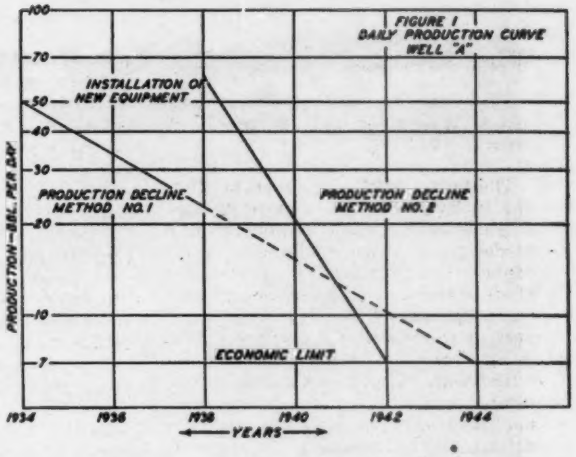


TABLE 1

(A) Method 1—Slow Withdrawal Rate and Old Equipment (Estimated Profit)

Year—	Barrels of gross oil per year	Barrels of net oil per year	Yearly net value, $1.10 per bbl.	Expense, operating and repairs	Yearly net profit	Yearly profit plus interest to 1-1-44
1938	7,480	6,545	$7,199	$2,160	$5,039	$6,431
1939	6,205	5,430	5,973	2,160	3,813	4,634
1940	5,110	4,470	4,917	2,160	2,757	4,345
1941	4,200	3,675	4,032	2,160	1,872	2,064
1942	3,395	2,970	3,267	2,160	1,107	1,155
1943	2,775	2,428	2,671	2,160	511	511
Total	29,165					$19,140
(B) Method 2—Fast Withdrawal Rate and New Equipment						
1938	16,780	14,670	$16,137	$2,910	$13,227	$16,881
1939	9,850	8,620	9,482	2,430	7,052	8,571
1940	5,770	5,050	5,555	3,218	2,337	2,705
1941	3,320	2,905	3,195	3,038	157	181
Total	35,720					$28,338

TABLE 2

(A) Method 1:	
Total estimated profit on operations to 1-1-44	$19,140
Salvage value of old equipment on 1-1-44	1,230
Total estimated profit by Method 1	$20,370
(B) Method 2:	
Total profit on operations to 1-1-44	$28,338
Salvage value of old equipment plus interest	1,570
Salvage value of new equipment less interest	1,255
	$31,163
Less investment cost on new equipment	4,632
Total by Method 2	$26,531
Increased profit from Method 2	$6,161

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Practically any combination of indoor and outdoor hazards can be efficiently handled by engineered applications of Cardox CO_2 Fire Extinguishing Systems.

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- Mass discharge of Cardox CO_2 "knocks out" fire, by . . .
- Reducing oxygen content of the atmosphere below the concentration necessary for combustion, and . . .
- Cooling combustibles and fire zone below ignition temperature . . .
- Extinguishing fire quickly and completely *without* damage from extinguishing medium.

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AUTOMATIC

CARDOX

NON-DAMAGING FIRE EXTINGUISHING SYSTEMS

Engineering Fundamentals

No. 106

A WEEKLY FEATURE OF THE OIL AND GAS JOURNAL

HOW PERMEABILITY IS DETERMINED

BASED upon the definition given for normal permeability in Installment 105 of this series, the equation by which the permeability may be calculated from laboratory measurements is:

$$K = \frac{Q \mu L}{A (P_1 - P_2)} \qquad (1)$$

where,

K = permeability of sample, darcys
Q = rate of flow of fluid through sample, cc. per sec.
μ = viscosity of the fluid under flowing conditions, centipoises.
L = length of sample in direction of flow, cm.
A = cross-sectional area of sample (perpendicular to direction of flow), sq. cm.
P_1 = input pressure to sample, standard atmospheres.
P_2 = outlet pressure from sample, standard atmospheres.

Strictly speaking, the above equation holds true only for liquids at low rates of flow. However, it is sufficiently accurate for practical purposes when applied to compressible fluids if the volume Q is corrected to the mean pressure, P_m existing in the sample. The mean pressure is calculated by taking the algebraic mean between P_1 and P_2 that is,

$$P_m = \frac{P_1 + P_2}{2}$$

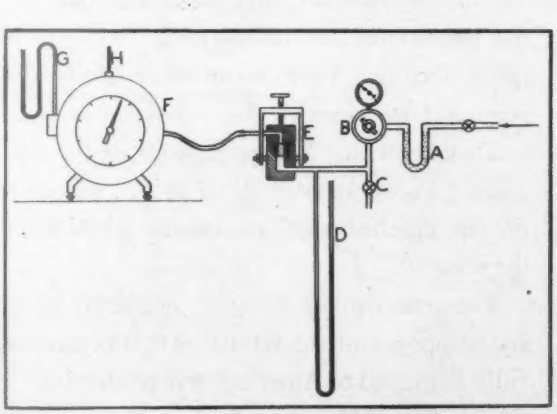
Air is probably the most commonly used fluid for measuring permeability in the laboratory, although oil and other liquids have been used by some testers.

Generally, the horizontal permeability, i.e., the permeability along a plane parallel to the bedding planes of the formation, is desired. However, it is often desirable to also measure the permeability perpendicular to the bedding. If a cylindrical sample is used, as described in the following procedure, the sample should be cut from the core so that the axis of the cylinder follows the direction in which the permeability is desired.

The small cylindrical sample required for the procedure described below is about ⅞ in. diameter and about 1 in. in length. A 2-in. sample may be drilled from a core using an electric-driven drill press of the type used in machine shops, but fitted with a special hard-faced coring bit and a connection for water circulation to keep the bit cool and carry the cuttings away. A dry sample should preferably be saturated with clear water before this drilling operation in order to prevent plugging of pores with some of the fine cuttings due to entry of the drilling water into the dry sample. Breaking of the 2-in. sample to a length of 1-in. will be described in the next installment.

An arrangement of apparatus suitable for determining the permeability of a sample, using air as the test fluid, is illustrated in Fig. 1. Compressed air at a pressure of 30 lb. per sq. in. or more is supplied from the volume tank of a small air compressor. The air from the volume tank passes first through a silica-gel drying tube A which removes any moisture content. An adjustable pressure regulator B is provided to give a constant pressure on the input side of the sample. A constant pressure regulator made for attachment to carbon dioxide cylinders has been found suitable for use in the permeability determination. A bleed-off valve C is needed on the downstream side of the regulator in order to allow reducing the downstream pressure by turning the adjusting screw of the regulator without damaging the regulator diaphragm. A manometer D, provided just ahead of the sample-holder, will allow reading of the input pressure on the core sample.

The sample-holder E can be made in a machine shop, by machining a recess to closely fit a No. 9 rubber stopper and providing a suitable connection for inlet of air on one side of the stopper and an outlet connection on the other side. The outlet connection is attached to the cap of the holder which is held in place by a stirrup and T-bolt as indicated in the sketch. The cylindrical sample is cut so that it is the same length as the stopper and is fitted tightly into a hole through the center of the stopper. It is important that the holder be so designed that there will be no leakage and that all of the air must pass through the core sample.



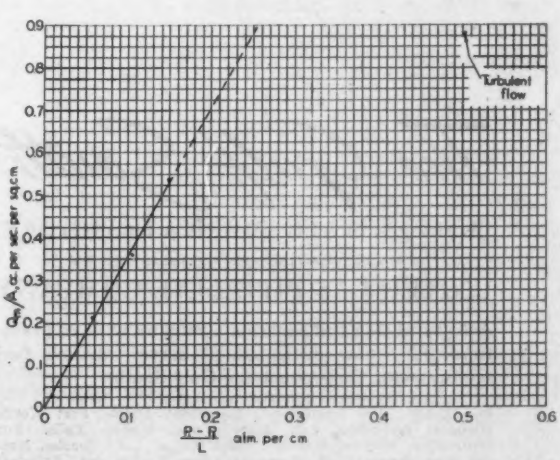
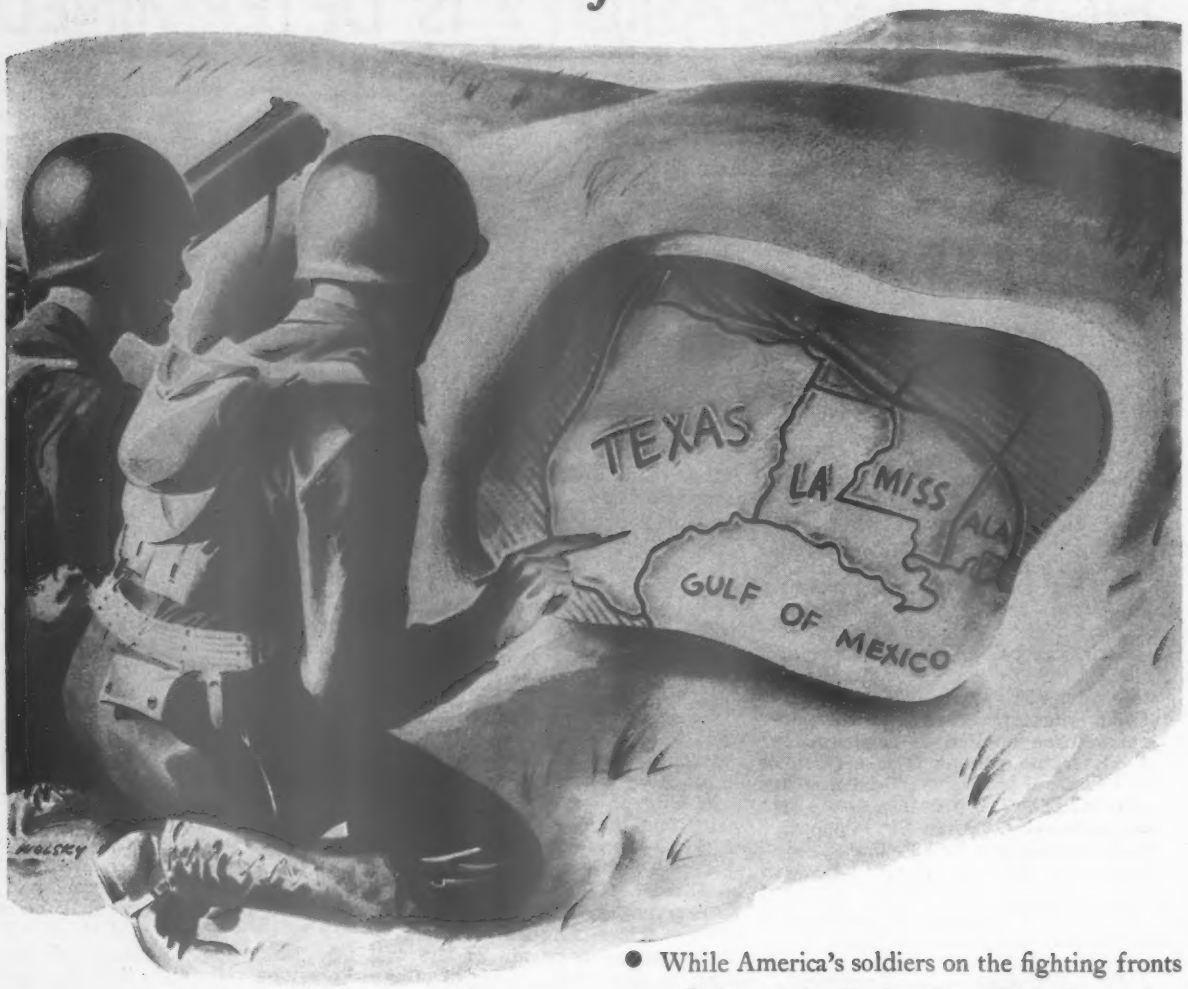


Fig. 1 (above) Fig. 2 (right)

Series prepared by Glenn M. Stearns, associate professor of petroleum engineering, University of Oklahoma

They're Co-operating 100% back home in the Gulf South!



● While America's soldiers on the fighting fronts are offering *their all*, they have faith that we on the home front are co-operating 100% to help speed Victory. They would be mightily disappointed if we weren't!

They know that Victory depends on the wholehearted co-operation of all of us . . . on our continuous, unselfish application to the job of winning the war.

The great natural resources, industrial capacity, and manpower of the GULF SOUTH have been fully harnessed to America's war production. The GULF SOUTH, like all America, is working harder and faster to produce the endless stream of supplies our fighting men must have—for VICTORY!

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A wet test meter F is suitable for measuring the rate of air flow through the sample. The manometer G will indicate the gage pressure at which the gas is metered which is also the outlet pressure from the core sample. The thermometer H gives the temperature of the air under test conditions. A barometer should be provided in the test room, and its readings recorded in connection with each test.

Illustrative Example

The method of calculation of results can best be explained by presenting a set of actual test data and following through all of the calculations involved. Test data are given in Table 1 and calculation of results are shown in Table 2.

The details of calculation can be understood by following through Run No. 1.

The diameter of the sample was measured in inches, whereas the cross-sectional area is desired in sq. cm. There are 2.54 cm. in 1 inch. Then,

$$A = (0.856 \times 2.54)^2 \times 0.785 = 3.71 \text{ sq. cm.}$$

The average length of the sample may be calculated by dividing its volume by its cross-sectional area. Then,

$$L = 9.4/3.71 = 2.535 \text{ cm.}$$

The viscosity of dry air at various temperatures is given in Table 3. From this table, it is found that the viscosity of the air on this test was 0.0182 centipoise.

A standard atmosphere is equivalent to 29.92 in. of mercury, then,

$$P_2 = \frac{28.64}{29.92} = 0.958 \text{ atm.}$$

There are 28,320 cc. in 1 cu. ft. Then the value in column 2 is obtained as follows:

$$\frac{Q}{A} = \frac{28{,}320 \times 0.01}{3.71 \times 330}$$

$$= 0.231 \text{ cc. per sec. per sq. cm.}$$

In column (3) is placed the manometer reading on the input side of the sample plus atmospheric pressure. For Run No. 1 this is,

$$4.5 + 28.64 = 33.14 \text{ in. mercury.}$$

Then,

$$P_1 = \frac{33.14}{29.92} = 1.108 \text{ atmospheres}$$

TABLE 1—OBSERVED DATA—PERMEABILITY TEST

Diameter of cylindrical core sample, in.	0.856
Volume of sample by mercury displacement, cc.	9.4
Barometer reading, in. mercury	28.64

Run No.	Input Pressure In. Hg. ga.	Outlet Pressure In. Hg. ga.	Volume of air at atmospheric pressure, cu. ft.	Flowing Temp. °C	Time Sec.
1	4.5	0	0.01	22	330.0
2	7.8	0	0.01	22	187.2
3	11.3	0	0.01	22	119.8
4	38.2	0	0.01	22	52.0

TABLE 2—CALCULATED DATA—PERMEABILITY TEST

Cross-sectional area of sample, sq. cm.	= 3.71
Length of Sample, cm.	= 2.535
Viscosity of flowing air, cp.	= 0.0182
Absolute outlet pressure, P_2, atm.	= 0.958

(1) Run No.	(2) Q/A cc. per sec. per sq. cm. at atmos. pres.	(3) Absolute Input pres., P_1 In.Hg.	(4) Atm.	(5) P_m, Atm.	(6) Q_m/A, cc. per sec. per sq. cm. at P_m	(7) $(P_1-P_2)/L$ atm.	(8) K
1	0.231	33.14	1.108	1.033	0.2145	0.0592	0.066
2	0.407	36.44	1.218	1.088	0.3585	0.1026	0.064
3	0.636	39.94	1.335	1.146	0.532	0.1488	0.065
4	1.469	66.84	2.233	1.595	0.882	0.503	*0.032

*Not true permeability, because of turbulent flow conditions.

and the mean pressure is,

$$P_m = \frac{1.108 + 0.958}{2} = 1.033 \text{ atmospheres}$$

By use of Boyle's law* the air volume measured at atmospheric pressure is corrected to mean pressure as follows:

$$\frac{Q_m}{A} = 0.231 \times \frac{0.985}{1.033}$$

$$= 0.2145 \text{ cc. per sec. per sq. cm.}$$

The pressure gradient through the sample for Run No. 1 is,

$$\frac{P_1 - P_2}{L} = \frac{1.108 - 0.958}{2.535}$$

$$= 0.0592 \text{ atm. per cm.}$$

Now, Darcys law (equation 1) can be applied only when the rate of flow is proportional to the pressure gradient. This can be tested by plotting the rate of flow, Q_m/A, for all four runs against the pressure gradient, $(P_1-P_2)/L$. Such a plotting for this example is given in Fig. 2. Then, all points that fall on the same straight line through the origin represent points from which the permeability may be calculated and will, from a practical standpoint, give the same permeability value.

Thus, it is noted that the data from the first three runs produce a straight line with the origin; and the permeability values calculated from these runs are 0.066, 0.064 and 0.065 darcy, respectively. Any one of these values, or the average of the three, may be reported as the permeability of the sand.

The value of K calculated from Run No. 4 is of no use, because, as shown by the fact that it does not fall in line with the other points and the origin, conditions of viscous flow did not exist during this run.

In accordance with equation (1), the value of K for Run No. 1 may be calculated as follows:

$$K = \frac{0.2145 \times 0.0182}{0.0592} = 0.066 \text{ darcy}$$

Averaging the first three runs, the permeability of this sand would be reported as 0.065 darcy, or 65 millidarcys.

*See Installment 10.

TABLE 3

Viscosity of Air at a Pressure of One Atmosphere (Kellstrom's Data)

Temperature, °C	Viscosity, Cp.
0	0.01709
10	0.01759
20	0.01808
30	0.01856
40	0.01904
50	0.01951

(Reproduced from A.P.I. code No. 27, Second Edition, April 1942, "Standard Procedure for Determining Permeability of Porous Media," American Petroleum Institute, Division of Production, Dallas, Tex.)

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REFINING

Purchase Offer Made for National Refining Co.

CLEVELAND, Ohio.—The National Refining Co. management here this week declined comment, neither confirming nor denying, reports that Otis & Co., Cleveland investment house, had made an offer to purchase the oil company's assets.

Officials of Otis & Co. admitted that negotiations were under discussion. Reports were that midwestern and eastern financial and oil interests, including Cyrus S. Eaton of Otis & Co., and Albert A. List, a Massachusetts investor, composed the group making the offer. Negotiations, it was reported here, were based on an offer of $8 a share for common stock, $100 a share for prior preferred certificates and $155 for old preferred.

National Refining Co. operates two refineries with combined crude capacity of more than 20,000 bbl. daily. The refinery at Coffeyville, Kans., was expanded last year, lifting crude capacity to 12,000 bbl. daily in order to operate a new aviation-gasoline plant at maximum efficiency. The Coffeyville plant is connected with the Great Lakes Pipe Line Co.

A selective catalytic polymerization unit was completed early this year at the company's Findlay, Ohio, refinery. The crude-oil distillation unit was modernized in recent months at Findlay, improving the over-all efficiency of the manufacturing operation. The company owns production in several Mid-Continent states and operates 786 miles of pipe line, varying in size from 2 to 8-in.

W. H. Lamprechet, II, is chairman of National's board and K. R. Proctor is president of the company.

Approval Expected on Two Synthetic Plants

DENVER, Colo. — Oscar Chapman, assistant secretary of the interior, in Denver, said last week that he is confident Congress will enact the O'Mahoney bill to provide funds to build two plants to produce synthetic gasoline from coal and oil shales, and that both will be located in Colorado.

Facts before his departure, he continued, show that natural-petroleum resources are being depleted and cannot last for many years. Drilling for new pools may be satisfactory, but the department's information shows that oil shale, especially, can produce sufficient gasoline and other products to save the situation.

Sketches of Plant Operators

GALE L. ADAMS, who was recently appointed process engineer of General Petroleum Corp., joined the laboratories department of the company in February, 1925.

Before joining General Petroleum he was a staff member of the development department of Standard Oil Co. of New Jersey for 5 years.

Mr. Adams served General Petroleum in general laboratory activities and geophysical operations until January, 1935, when he became supervisor of process laboratories. In 1941 he was promoted to assistant manager of laboratories.

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ALLOY TUBES MAY REQUIRE TWO ROLLING OPERATIONS

Before rolling, the characteristics of the tube composition should be studied to determine the amount of creep to expect so the tube can be lined up accordingly. If a tube alloy is such that a degree of work hardness should develop, it is preferable to make two operations for each rolling. During the first operation, heating of the tube walls will occur and will result in the expansion of the tube against the header which is at a lower temperature. As this cools, the shrinkage may be sufficient to draw the tube from the header, causing leaks. The second operation should be just a fraction of the ultimate rolling depth and can be done quickly without much temperature increase. This operation is also effective in eliminating the essential contraction created during the cooling of the tube after the first operation.

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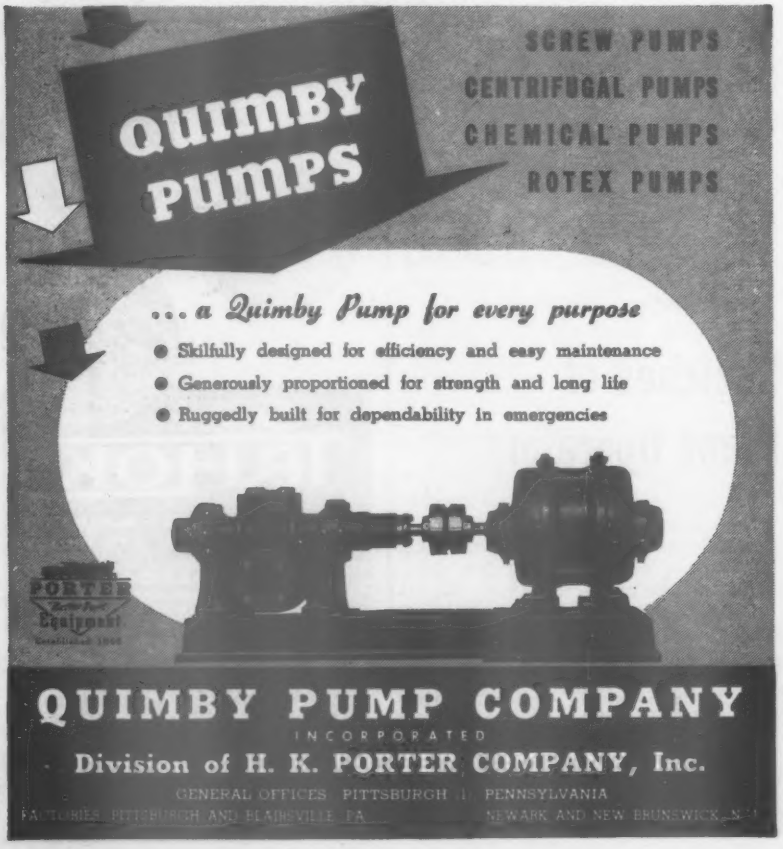
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Early this year he was made a member of Socony-Vacuum's refinery process committee which passes on all process considerations of Socony-Vacuum, its subsidiaries and affiliates. General Petroleum Corp., a pioneer California company, com-

GALE ADAMS

pletely integrated, is a subsidiary of Socony-Vacuum and John Brown, president of the latter, was previously president of General Petroleum before going to New York as chief of Socony-Vacuum. In addition to being process engineer, Mr. Adams is also assistant manager of laboratories.

Ernest Hughes Appointed District 2 Marketing Chief

CHICAGO.—Ernest L. Hughes, formerly president of the Hughes Oil Co., Chicago, has been appointed director of marketing for PAW District 2.

The new marketing director has been engaged in this phase of operations since January 1916, when he joined the Oil Marketing Co., Tulsa.

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PIPE LINES

WEP Continues to Test New Jersey Lateral

War Emergency Pipelines, Inc., continues to apply severe tests to 86 miles of 20-in. pipe of the crude-oil lateral serving New Jersey to insure that pipe can withstand abnormally high pressures which might occur in the course of operation. More than half of the breaks resulting from water-pressure testing are confined to a 5-mile stretch.

Although there is now sufficient pumping capacity on the WEP 24-in. extension east of Norris City, Ill., to move 225,000 bbl. daily, the present throughput is being held down to 175,000 bbl. daily until testing is completed east of Phoenixville, Pa., on the New Jersey lateral.

By the end of this week it is expected that all work on laying the WEP 20-in. products line from the Gulf Coast to Norris City will be completed, since only a few small gaps now remain. Completion of stations is being postponed for possibly another month because of delays in receiving certain items to complete installations. Considerable borrowing is being done to meet the emergency situation.

Controls Are Improved for WEP 20-In. Products Line

According to the original design of controls for War Emergency Pipelines, Inc.'s products stations, described in an article, entitled "Design of WEP 20-in. Products-Line Pump Stations," on page 156 of this issue, there would be sequence shutdown of units if pump-case pressure should exceed 1,000 lb. or if mainline pressure should exceed 825 lb. In that case, Units 1, 2 and 3 at a station are shut down in that order.

Recent changes in the design have been made which mean that these shutdown operations do not occur until the discharge valve is open.

Contracts for Magnolia Line to Be Let Oct. 1

Contractors have been going over the route of the Magnolia Pipe Line Co. project which will provide another outlet for West Texas crude. Specifications have been issued and it is expected that contracts will be let on October 1.

Arrangements have been made for having half of the new 12-in. pipe delivered in the fourth quarter of this year. Work is to start about November 1. The project consists of 335 miles of new 12-in. pipe paralleling the present line of the company from Midland to Corsicana, Tex., and 46 miles of second-hand 8-in. loops between Midland and Seminole, Tex. Pipe for the project with the exception of 30 miles will be protected by Magnolia's Conite coating with wrapping.

Second-hand electric-driven reciprocating units for the new line will be added to pump stations at Midland and Sweetwater, Tex., which will be salvaged from the company's system; these, together with equipment to be added to the De Leon station will give a capacity of 42,000 bbl. daily. By addition of pumping equipment at four other stations capacity could be raised later to 60,000 bbl. daily.

Stanolind's Elk Basin Outlet Is Approved in District 4

DENVER, Colo.—The PAW District 4 transportation committee of which Burton W. Musser, of Salt Lake City, Utah, is chairman, has approved the application of the Stanolind Pipe Line Co. for a permit to build an outlet for the Elk Basin field in northern Wyoming, and its recommendation has been sent to Washington, where the company applied for a permit. The application was referred to the committee for its recommendations.

Details for the projected line are not reported, but from general information available here it is expected that it will be approximately 200 miles long and will consist of not less than 8-in., and probably of 10-in. pipe, and will run southward from the field to the vicinity of Thermopolis, Wyo., and thence eastward to the Salt Creek field, or to the Casper, Wyo., tank farm; it will tie in with the company's trunk line from that field to Freeman, Mo. A more direct route probably would be shorter by 50 or more miles, but factors other than distance have to be taken into consideration. This route would enable it to serve not only Elk basin, but the fields along the western rim of the Big Horn basin

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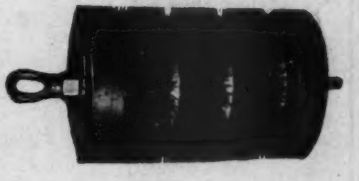

For five years many pipe line companies have found that the MOLE CLEANER really cleans the pipe line. Put it in ahead of a slug and see the dirt come out.

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The H & M Pipe Cutting and Beveling Machine cuts any size pipe with speed, economy and accuracy.

SPEED: Complete cut and bevel can be made on 12 inch pipe in about 2 minutes.

ECONOMY: Save approximately one-half labor and gas costs.

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including Oregon basin, Grass Creek, Little Buffalo basin and a number of smaller fields, and will avoid expensive construction in mountainous districts.

It is believed here that the project will be put through with the utmost speed once the certificate of authority is granted, priorities are arranged, and the preliminary details are completed. Under favorable conditions the line could be finished and put into operation next spring. Construction during the winter will handicap its progress, but under ordinary conditions 2 or 3 months remain before the cold weather sets in in that district, and it is pointed out that time can be saved by transferring to the job crews which recently completed the Big Inch line.

The construction of this line is expected to put an end, at least temporarily, to the move which has been under way recently for the building of a pipe line to the Pacific Northwest with the aid of federal funds. That project would take considerable time to go through the Washington red tape, and it is probable that the Stanolind line could be built and put into operation before these preliminaries could be ironed out, and would remove the necessity for other outlets from the field. It is understood that the Ohio Oil Co., one of the principal producers of black oil in the Big Horn basin, conducted negotiations with a view to joining with Stanolind in the project, but that this plan has been abandoned, and it will be strictly a Stanolind undertaking. Through connections between the Stanolind line to Missouri, and the Utah Oil Refining Co. line from Lance Creek to Salt Lake City, in eastern Wyoming, oil could be moved from the Big Horn basin to the Utah refinery, which is controlled by Standard Oil Co. of Indiana, but such a possibility lies in the future. The Utah line now transports crude (lighter grades) from Lance Creek, Rock River, Quealy, Big Medicine Bow, La Barge, and other fields along the southern route, and will have no need for large quantities from the Big Horn basin for some time to come.

Colley of Bechtel Co. Is A Japanese Prisoner

Unreported in the South Pacific war zone since the fall of Manila, George S. Colley, Jr., vice president of W. A. Bechtel Co., is alive and well on Borneo, although a Japanese prisoner. This news was transmitted on August 21 through the International Red Cross headquarters at Geneva.

Mr. Colley, identified with pipeline construction activities, was engaged in building augmented naval and air facilities at Cavite on Manila Bay when war was declared. He was directing construction for his company as project manager under ocean-wide naval contracts being executed by Contractors Pacific Naval Air Bases. Both at Cavite and across the bay on the cliffs of Bataan the construction organization continued its work under constant attack until forced to capitulate by the proximity of Japanese occupational forces.

In early January 1942, Mr. Colley, together with his wife, Mr. and Mrs. Harry Webber and Ashton Laidlaw left Manila in a motor launch. They were traced as far as Balabac Strait northeast of Borneo, and before reaching this point the party had transferred to a small sail boat.

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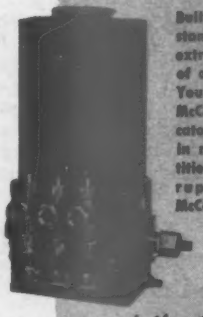

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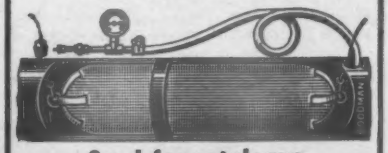

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Exploration and Drilling

Week's Highlights

THE reported finding of oil and gas showings in the Silurian in the deep test at McCamey, Texas, (p. 266) will probably give a good many geologists headaches in the future. The original discovery in the Silurian made by Gulf at Shipley in Ward County presented few problems. It could be explained as a normal correlative of the Fusselman limestone which was known farther to the west. A basin could be postulated beneath the Permian limestone with the lower formations, including Devonian and the Simpson, as well as the Silurian, lying between the Permian and the Ellenburger. Just across the Crane County line, these series were pinched out.

However, in the Abell field, the Simpson reappears, together with an overlying limestone, the Montoya. In the Apco field, this again pinches out. The finding of Silurian production at McCamey indicates that there is an Ellenburger ridge running from Sand Hills through McElroy, paralleling the Fort Stockton high and that in the pre-Permian basin lying between these ridges almost anything may happen. Simpson production in Abell added to the Silurian showings at McCamey and the Shipley production add to the number of prospective pays below the Permian and show the need for searching for this deeper oil on the flanks of Ordovician highs as well as on their crests.

Several years ago a number of Mid-Continent geologists found that there was great need for paleogeological maps showing the distribution of formations below the Pennsylvanian. Varying conditions along the Pecos Valley show the same need in West Texas for maps on the pre-Permian surface.

Reference to declining gas production in the East (p. 277), together with the controversy as to whether additional gas from the Hugoton-Panhandle area should be taken to the eastern area, again stresses the increasing importance of gas. The question has many angles beginning with the crying over wasted gas in the Trenton fields of Indiana and other eastern areas in the early days and continuing to the giant flares of the Illinois basin fields. Southwestern states are now aware of the value of their gas and they are taking steps to conserve it.

It seems that there has never been sufficient realization of the value of gas by producers. They have been willing to sell it for a few cents a thousand and its cheapness made waste inevitable. Obviously, conservation is not economic if it costs more than the value of the commodity saved. Gas producers have been at a disadvantage, as compared with oil producers, in that the major purchasers of gas were often not producers themselves. Consequently, gas always sold on a buyers' market. Most casinghead gas is stripped but there is not sufficient value in the residue to enable it to be run to depleted fields and stored until a market presents itself.

Whether gas should be transported into other parts of the United States or not is not a matter for discussion in this place but it seems that if it is in such demand, this increased demand should be reflected in increased prices. There is much concerted effort to attempt to bring the price of oil up to an adequate level. Oil producers, who are also gas producers, might be well advised to look also into the question of the economics of gas production.

OHIO: A Pennsylvania Grade pool has been opened southeast of Zanesville (p. 278).

CALIFORNIA: Production has been found in the Stevens zone southeast of Greeley and a new field is in prospect west of Round Mountain (p. 262).

COMPLETIONS IN ALL FIELDS . . .

(Week ended September 18, 1943)

	Oil	Gas	Dry	Total	Footage	Total Comb. to date 1943	1942
N. Y., Penna., W. Va.	50	16	2	68	139,212	2,432	2,461
Ohio	5	7	17	29	73,409	637	782
Indiana	2	0	3	5	8,441	163	235
Kentucky	4	2	4	10	16,134	285	149
Illinois	21	0	21	42	108,592	1,238	1,230
Michigan	5	1	11	17	38,284	418	500
Kansas	16	1	16	33	114,693	1,148	1,121
Nebraska	0	0	2	2	7,597	22	25
Missouri, Iowa	0	0	1	1	820	11	10
Oklahoma	7	1	17	25	73,362	848	865
Texas:							
North Central Texas	17	0	15	32	71,551	1,021	820
West Texas	17	0	6	23	101,917	809	1,032
Texas Panhandle	3	1	0	4	11,522	131	271
Eastern Texas	5	0	2	7	39,375	203	287
Texas Gulf Coast	1	2	6	9	61,548	320	535
Southwest Texas	12	3	8	23	112,333	652	786
Total Texas	55	6	37	98	398,248	2,936	3,731
North Louisiana	1	0	1	2	3,927	221	340
Louisiana Gulf Coast	4	0	2	6	41,879	260	361
Total Louisiana	5	0	3	8	45,806	481	701
Arkansas	0	0	3	3	8,490	176	129
Mississippi and Southeast	0	0	1	1	2,538	59	41
Montana	2	0	0	2	4,591	153	134
Wyoming	5	0	1	6	27,025	97	76
Colorado, Utah	0	0	0	0	0	18	14
New Mexico	0	0	1	1	2,009	155	169
California	23	2	3	28	90,898	936	523
Total United States	200	36	143	379	1,160,047	12,213	12,908
Total previous week	213	42	130	385			
Week ending Sept. 19, 1942	195	48	113	356			

CALIFORNIA

Stevens Zone Productive in Wildcat South of Greeley

LOS ANGELES, Calif.—In completing its 1-G Kern County Land a few days ago, Continental Oil Co. may have proved up the existence of a new field approximately 3 miles southeast of the Greeley field in Kern County. The discovery was good for 265 bbl. initially from a 12-ft. section in a 26-ft. interval of sand at 7,489-4,501 ft. This new well shows a gas-oil ratio of 800 cu. ft. of gas per barrel of crude oil, a favorable condition from one standpoint but not too good as far as indicating the existence of a high-pressure field.

Present production is coming from the equivalent of the Stevens oil sand of Miocene age and the possibility that 1-G Kern County Land may be an edge well is indicated by the fact that on a formation test some time ago at 7,462-7,540 ft. the well flowed at a daily rate of 700 bbl. of 31-gravity oil and salt water, a condition common to edge wells or wells that have encountered bottom water. If Kern County Land will approve a delay in the drilling of 1-H in 18-20s-26e, Continental will begin a second well at McClung on acreage leased from Kern County Land.

Completion of Continental's new well at McClung southeast of the Greeley field is of interest because of a test being started by Union Oil Co. in the Rio Bravo area to the northwest. Union's test will be a Stevens zone well and will not be carried down to the Rio Bravo and Vedder zones. Interest in Stevens sand tests has increased during the past several months and especially since Superior Oil Co. secured good production from a relatively thin streak of Miocene in the Lanare-Wheatville district of Fresno County.

Extension well. — Amerada Petroleum Corp. is believed to have extended the productive limits of the Thornton field of Sacramento County which it discovered a short time ago by completing 1 Housken Community flowing 6,852,000 cu. ft. of gas daily from 3,285-3,350 ft. This well is located about 2 miles northwest of the discovery well at Thornton and the next step will be to drill a test between the two holes. This third well will determine definitely whether 1 Housken Community is located on the Thornton structure or whether it has found a separate gas accumulation.

New gas discovery. — Texas Co. should complete its discovery well, 1 Moffatt, 7-12s-15e, in the Firebaugh district of Madera County within the next few days. Last week this discovery was given a formation test and showed a potentiality of 8,000,000 cu. ft. of gas daily. The flow was later killed in order to permit the crew to complete in the conventional manner. The productive interval at 3,960-73 ft. is probably the equivalent of the upper Gill zone found at Mendota in the Eocene. Firebaugh is approximately 10 miles northwest of the Mendota gas field, also discovered by Texas Co., and also located in Madera County.

Probable new oil field. — Bandini Petroleum Co. has probably found a new oil field approximately 2 miles west of the southern tip of the Round Mountain field in Kern County as 1 Signal Mills in 24-28s-28e has been completed pumping 140 bbl. of 16.5-gravity oil daily from 2,435 ft. Production is cleaning up and it is believed that after the well has been on production for another few days the cut will not exceed 2 or 3 per cent. Production is coming from the Vedder oil sand of Miocene age at 2,413-35 ft. and although the discovery did not have enough gas to kick over, it is showing satisfactory production on the beam. General Petroleum has offset acreage to the northwest and as soon as a road has been finished will start actual drilling in 23-28s-28e.

Kern County. — Texas Co. has apparently picked up the Williamson oil sand in the north end of the Lost Hills field in 2-20 Theta in 2-26s-20e as this well cored 12 ft. of oil sand at 1,411-23 ft. The company has landed a string of 7⅝-in. casing at 1,383 ft. preparatory to an early production test.

LOS ANGELES BASIN

Los Angeles County.—Standard is completing 13 Gough as a gas well in the El Segundo field and has location staked for 14 Gough. This gas is being developed for use in the El Segundo refinery but if the volume developed is sufficiently large it could be disposed of to Southern California Gas Co. for local distribution. One gas well in this field producing from the Gough zone, which is a dry-gas horizon, has been producing for some time and Standard hopes to produce from the same zone. Texas is getting ready to spud in 1-D Fields, a projected deep test in the Long Beach field and should begin making hole within the next few days.

COASTAL DISTRICT

Santa Barbara County.—A. E. Bell completed a peculiar well in the Lompoc district when 6 Lompoc in 28-8n-34w was brought in pumping 80 bbl. of 6-gravity oil per day. It is questionable whether to call this well a completion as the operator is obliged to inject 50 bbl. of 20-gravity oil in order to reduce the viscosity sufficiently to permit pumping. This well is bottomed at 4,997 ft. with an effective depth of 4,803 ft. Bottom-hole temperature is reported at 170°, not an abnormal condition for this area.

Ventura County. — Pacific Western Oil Co. is drilling and coring in 14 Temescal, a deep test in the Temescal field, but at 10,200 ft. the operator has not yet found the anticipated deep sand. In the Torrey Canyon field, Union Oil Co. has abandoned the lower part of the hole in 60 Torrey and has plugged back from 6,146 ft. to 3,030 ft. where some showings were logged between 2,940 ft. and 3,030 ft.

DAILY AVERAGE PRODUCTION FOR WEEK

	Sept. 18 crude oil	Distillate, allied products	Sept. PAW quota all oils	Sept. 11 crude oil
Arkansas	77,345	4,000	80,100	76,645
California	788,150	46,000	835,000	785,150
Colorado	6,950	.....	6,500	6,615
Eastern fields	74,250	7,300	86,600	78,350
Illinois	227,500	11,500	222,800	211,400
Indiana	14,100	.....	13,800	13,300
Kansas	296,900	5,100	300,000	290,450
Kentucky	22,550	2,300	25,500	20,850
Louisiana	360,325	27,000	375,000	360,625
North Louisiana	82,325	.....	.....	82,125
Louisiana Gulf Coast	278,500	.....	.....	278,500
Michigan	58,600	100	60,100	59,100
Mississippi	48,835	.....	50,000	49,155
Montana	22,015	300	23,300	21,570
Nebraska	1,800	.....	2,000	1,800
New Mexico	105,000	5,400	116,600	105,100
Oklahoma	327,350	27,000	347,000	327,200
Texas	1,837,650	116,000	1,909,000	1,832,350
East Texas	380,000	.....	.....	380,000
West Texas	333,500	.....	.....	332,500
North Central Texas	140,600	.....	.....	140,600
East Central Texas	130,700	.....	.....	130,200
Texas Panhandle	104,000	.....	.....	104,000
Texas Gulf Coast	654,800	.....	.....	651,000
Southwest Texas	94,050	.....	.....	94,050
Wyoming	98,900	2,000	98,800	99,955
Total United States	4,368,710	253,900	4,552,100	4,339,615

Total production January 1-September 18, 1943 ..... 1,045,348,170 bbl.
Same period last year ..... 989,077,110 bbl.

N. CENTRAL TEXAS

Two New Fields Found In Young County

WICHITA FALLS, Tex.—Two new oil fields were discovered in Young County last week. In the southeast part of the county, 3 miles southeast of Oil City, Lupton & McLester completed their 1 C. W. Johnson estate, 660 ft. from north and west lines of F. M. Diew Survey, from Marble Falls pay at 3,990-4,007 ft. The discovery flowed 235 bbl. of oil in five hours through ¼-in. choke on tubing with casing pressure of 1,200 lb. and tubing pressure of 300 lb. The operators have moved in on a west offset. British-American Oil Producing Co. 1 Carpenter-Barrett, 330 ft. from south and east lines of the north 56½ acres of the south 225 acres of the east 450 acres of E. W. Sargent Survey, 2½ miles north of Loving, total depth 5,537 ft., opened a new Mississippi lime pool when it flowed 289 bbl. of oil and 219 bbl. water through perforations 5,185-95 ft. Top of the Mississippi lime was called at 5,180 ft., and top of the Ellenburger was 5,410 ft., which tested salt water from 5,417-5,530 ft. on drill stem test. The Mississippi lime pay was acidized with 1,000 gallons.

Clay County.—The Joy-Mississippi lime pool was assured a half-mile east extension at R. H. Dearing & Sons 1 Chilson heirs, 442 feet from north, 515 ft. from west lines of Lot 28, H. Williams Survey, which topped the Mississippi lime at 6,050 ft., and after taking two cores from 6,081-99 ft. and 6,099-6,105 ft., kicked out mud and oil, and threatened to get out of control while attempting to run 5½-in. casing. Casing was hung at 6,081 ft., but due to the high pressure, special equipment had to be ordered to cement the pipe.

Wildcat Locations

Archer County.—G. E. Kadane & Sons 1 Jones & Cullum is located 300 ft. from north and east lines Sec. 2, S.P. Ry. Co. Survey A-1,255, 1½ miles east of Mankins, for 4,500-ft. rotary test.

Clay County.—Shell Oil Co. 1 R. F. Wynn, 330 ft. north, 1,140 ft. west of northeast corner J. Cook Survey, A-751, but in C. Rooney Survey, A-392, is new 6,400-ft. rotary test 4 miles west of Bellevue.

Young County.—Belfort Oil Co. and Auto Ordnance Co. 1 G. R. Whitely is new 5,100-ft. rotary wildcat, 467 ft. from north and west Section 414, T.E.&L. Survey, 2 miles northeast of Newcastle.

NORTH TEXAS WILDCAT COMPLETIONS

Archer County: Hedrick Oil 1 B. A. McCluer, 1,650 ft. from E, 330 ft. from S, Sec. 2,468, T.E.&L. Sur., dry, T.D. 1,557 ft.

E. C. Norwood Est. 1 Lorena Kinder, 660 ft. from N & W, Blk. 50, Clark & Plumb subd., Caddo 5,124 ft., Mississippi 5.746 ft., dry, T.D. 5,811 ft.

Clay County: Tom B. Owens 1 Gus Blakeley, 660 ft. from N & W. Blk. 79, Freestone County School Land, Marble Falls 6,090 ft., Simpson 6,828 ft., dry, T.D. 7,166 ft., O.W.D.D. from 6,110 ft.

Cooke County: Benson Bros. 3 J. H. Cooke, 600 ft. from N, 400 ft. W, 270 ft. S of well No. 1, 438-ac. tract, A. Patterson Sur., dry, T.D. 1,183 ft.

D. L. Monroe 1 W. R. Thornton, 180 ft. from E, 233 ft. from S, 40-ac. leases, L. C. Gibbs Sur., dry sand 985-1,015 ft., sand showing oil 1,348-58 ft., odor oil 1,498-1,509 ft., dry, T.D. 1,557 ft., shale.

WEST CENTRAL TEXAS

ABILENE, Tex.—New locations for 3,500-ft. test, 2 miles north of Anson, Jones County, is Merry Bros. & Perini and Alder Oil Co. 1 W. B. Agnew, 330 ft. from south and west lines of 200-acre tract in Section 44, B.B.B.&C. Ry. Survey. In Taylor County, Grapeland Oil Co. 1 J. T. Warren estate, J. W. Page Survey, 3,500-ft. wildcat test, was drilling below 3,000 ft. In Parker County, Continental Oil Co. 1 J. R. Davidson, 6½ miles northwest of Weatherford, was drilling below 5,400 ft. in Marble Falls lime.

WEST CENTRAL TEXAS WILDCAT COMPLETIONS

Callahan County: Clyde D. Lane 1 Raymond DeBusk, 330 ft. from N, 610 ft. from E, 20-ac. lease, Rebecca Edwards Sur., dry, T.D. 1,417 ft.

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PERMIAN BASIN

Oil and Gas Showing in Silurian in McCamey Test

MIDLAND, Tex. — Texas - Pacific Coal & Oil Co. 52-A Lane, 1,650 ft. from south, 990 ft. from east line Section 5, G.C.&S.F. Ry. Co. Survey, old well drilling deeper in the McCamey pool, Upton County, reported top of the Silurian at 7,115 ft., and on drill-stem test from 7,105-7,203 ft. tested 109,000 cu. ft. gas, and recovered 800 ft. oil-cut mud after testing tool was open 47 minutes. The test is drilling ahead, with top of the Montoya called at 7,203 ft., and at last report was past 7,250 ft., with the Ellenburger as its objective. The only Silurian production in West Texas is in Ward County, discovered in 1940 at Gulf Oil Corp. 5 Wristen Bros., Section 18, Block 5, H.&T.C. Ry. Survey, 42 miles west and a little north of the Texas-Pacific prospect. Top of the Silurian was called at 6,835 ft., with the Montoya at 7,400 ft., and the Ellenburger at 9,002 ft. A correlation shows that the new prospect is only 198 ft. lower on top of the Silurian than the discovery. Observers say that the showing in the Upton County well was comparable with that in the Ward County producer, and since this formation reacts favorably and readily to acid treatment, it is believed that, in the event the Ellenburger is dry, the test will be plugged back and completed as a producer from the Silurian.

Andrews County.—Texas Co. 1 John Mabee, NE SW Section 37, Block 40, G.&M.M.B.&A. Survey, southeastern part of the county, had top of the San Andres lime at 4,640 ft., with some saturation and porosity in samples from 4,640-46 ft., and a core from 4,646-60 ft. recovered 14 ft. of lime with oil stains. Another core from 4,660-67 ft. recovered lime with oil stains and slight porosity, and the test was drilling ahead below 4,690 ft. It is 2 miles east of a dry hole which had show of oil from 4,762-63 ft. New wildcat to test the Clear Fork Horizon was staked 4½ miles northeast of nearest producer in the Fullerton pool and 6½ miles east of Union Oil Co. 1 J. D. Biles, new discovery. It is Ralph Lowe 1 Fee, in SE SE Section 21, Block A-26, Public School Land. Attempt to extend the Embar-Ellenburger pool south ½ mile failed when Phillips Petroleum Co. 1 Embar, an old gas well drilled deeper, encountered sulfur water in drilling to total depth 8,576 ft., and the well was plugged back to 6,280 ft. to attempt completion in the Clear Fork pay.

Two additional wildcats to test the Ellenburger were announced during the week. In Mitchell County, Shamrock Oil & Gas Co. 1 Ellwood Estate is located in NW NE Section 19, Block 17, Southern Pacific Ry. Co. Survey, 4½ miles west of an Ellenburger failure at total depth 8,002 ft., drilled by Humble Oil & Refining Co. on the Ellwood Ranch. This test topped Strawn at 2,660 ft., and Ellenburger at 7,818 ft. In Pecos County, Globe Oil & Refining Co. and Forest Development Co. will drill 1 Colden, 660 ft. from southwest and southeast lines of Section 40, Block 10, H.&G.N. Ry. Co. Survey, 3½ miles southwest of the Abell pool, and 5½ miles northwest of the Apco-Warner pool, the new test being cut off from both pools by dry Ellenburger tests.

WEST TEXAS WILDCAT COMPLETIONS

Andrews County: Union Oil Co. of California 1 E. P. Cowden, 660 ft. from N, 1,980 ft. from W, Sec. 18, Blk. A-55, Public School Land, elev. 3,121 ft., Anhydrite 1,330 ft., dry, T.D. 2,878 ft.

Runnels County: L. E. Hults 1 C. C. Gray, 990 ft. from N, 330 ft. from W, subd. 42, E.T. Ry. Co. Sur., elev. 2,727 ft., dry, T.D. 2,415 ft.

Yoakum County: Texas Co. 1 J. B. Miller, 660 ft. from N&W, Sec. 180, Blk. D, J. H. Gibson Sur., Yates 3,070 ft., Brown lime 4,020 ft., San Andres 4,460 ft., dry, T.D. 6,080 ft.

PANHANDLE

AMARILLO, Tex.—Six new locations were staked in the Panhandle field during the week, with Gray

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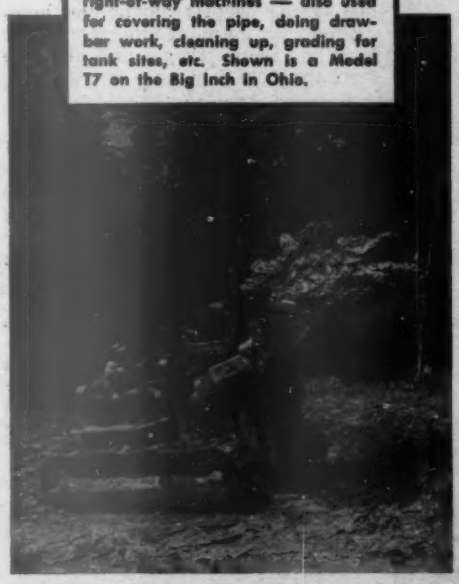

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County getting three of the new tests, and the other three being divided among Moore, Hutchinson and Potter counties. It was reported that Pure Oil Co. would drill an Ordovician test in Dallam County, on its block centering on Section 13, Block 18, Capitol Syndicate Lands, with the location probably being in the northeast corner of Section 13. In Donley County, Shamrock Oil & Gas Co. 1 Cornelia Adair was shut down at total depth 5,358 ft. in granite.

TEXAS GULF COAST

Discovery West of Louise Is Fair Producer

HOUSTON, Tex.—The 1 Claude Appling, closely watched wildcat test of W. Stewart Boyle et al, a mile west of Louise, in Wharton County, was flowing an estimated 10 bbl. of oil into tanks through 5/64-in. choke daily as the week closed. Tubing pressure was 900 lb. and casing pressure 1,300 lb. Humble Oil & Refining Co. has staked location for 1 F. B. and Donald Duncan, in the Spanish Camp area of Wharton County. Edmund Neilson was drilling at 6,735 ft. in shale at 1 H. V. and I. V. Duncan, in the Lissie area of the same county.

Humble 1-B Texas Long Leaf Lumber Co., another wildcat drawing unusual interest, 1½ miles northwest of Splendora, in Montgomery County, was abandoned at 11,023 ft. This operation, an attempt to open Wilcox production in the Splendora area, was one of the deepest among the holes drilled with the same objective. Other tests had recovered gas and distillate from the Cockfield.

Jefferson County is witnessing increased activity. Glenn H. McCarthy, Inc., et al has staked location for 1 Texas Public Service Co., 5 miles southeast of Nome. Projected depth is 9,000 ft. Rowan Drilling Co. is rigging up for 1 Broussard, 4½ miles southeast of Fannett. Texas Co. was coring at 7,448 ft. in shale at 1 S. D. Barnes. It topped salt-water sand at 7,280 ft. Sun Oil Co. has reported no shows yet at 1 B. E. Quinn, 5 miles northwest of Beaumont. Total depth was 7,812 ft. at latest report. McCarthy was drilling at 3,755 ft. in shale at 2 Hebert, 4 miles southwest of Viterbo.

TEXAS GULF COAST WILDCAT COMPLETIONS

Chambers County: Butcher-Arthur, Inc. 1 Sherman et al, 3½ mi. NE of Wallisville, dry, at 6,216 ft.

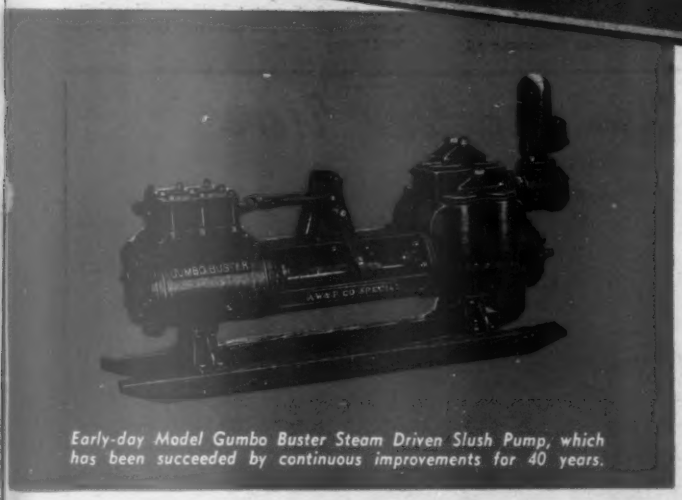
Matagorda County: Ohio Oil Co. 1-A J. E. Pierce, 1½ m. NE of Blessing, dry at 9,917 ft.

Montgomery County: Humble 1-B Texas Long Leaf Lumber Co. et al, 1½ mi. NW of Splendora, dry at 11,023 ft.

GUMBO BUSTER'S G-300

IS THE RESULT OF 40 YEARS CONTINUOUS PUMP IMPROVEMENTS

G-300 Gumbo Buster Power Pump, the Slush Pump of To day . . and Tomorrow.



Early-day Model Gumbo Buster Steam Driven Slush Pump, which has been succeeded by continuous improvements for 40 years.

The Gumbo Buster G-300 Power Driven Slush Pump is a far cry from the little 8" x 5" x 10" Special Duplex Steam Pump built in the grass-root days of rotary drilling . . weight, 2,000 lbs., price, $235.00. But the G-300, pace-setter for modern-day slush pumps, is the outgrowth of that 1902 model which, in its day, was the No. 1 means of delivering fluid under pressure into drilling wells . . for the Gumbo Buster line of pumps today represents year-by-year improvements over the original Gumbo Buster pump designed 40 years ago

The 7¼" x 16" G-300 overhanging crank type, full roller bearing power pump develops 300 h.p. at 60 r.p.m. The all-steel (electric cast) fluid end, tested to 4,000 lbs. p.s.i., is cast in four pieces and welded together to eliminate gaskets. Twice the strength of iron fluid ends, it likewise permits welding should it cut out behind liners or valve seats.

Complete specifications of design, materials and construction on the G-300 Power Pump, and other Gumbo Buster equipment, are available by writing for Bulletin No. 802 . or in the 1943-44 Composite Catalog now being published

In addition to the G-300, Gumbo Buster also makes the following all-steel fluid end power pumps, on which specifications will also be gladly furnished; G-150, 7" x 14", 150 h.p. eccentric type and G.O.C.-225, 7½" x 14", 225 h.p., overhanging crank type.

GUMBO BUSTER PRODUCTS

- Rotaries and Rotary Drive Transmissions
- Draw Works for Steam, Electric and Power Rigs
- Rotary Drilling Engines (Steam)
- Slush Pumps (Geared Power and Steam)
- Boiler Feed and High Pressure Pumps
- Crown and Traveling Blocks
- Pump Liners and Rods
- Swivels
- Slush Pump Valves and Seats
- Line and Throttle Valves (Steam)
- Reverse Clutches
- Kelly Joints
- Rig Lighting and Utility Units

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ILLINOIS

Gulf Opens Two Pools in Jefferson and Marion

CENTRALIA, Ill. — Gulf Refining Co. has opened another pool in Jefferson County with its 1 McNail, NW SE NE 23-1s-4e, which, after a 2,000-gal. acid treatment, swabbed through tubing at the rate of 450 bbl. per day and after the tubing was pulled swabbed 276 bbl. in 9 hours or at the rate of 720 bbl. per day from McClosky lime at 2,889 ft. The company made a location for 2 McNail in NW SW NW 24-1s-4e, and is rigged up on 1 Ella Stahler, SE NW NE 23-1s-4e.

National Refining Co. 1 Lawrence, S½ NW SE 32-2s-9e, Wayne County, a wildcat, showed gas and oil in a drill-stem test of McClosky lime at 3,314-20 ft. It made two flows before being shut in.

Gulf Refining Co. 1 Floyd, SE SE NW 25-1n-3e, Marion County, a wildcat, swabbed 225 bbl. after acidizing McClosky lime at 2,730-40 ft.

Forty-two wells were completed in the state during the week, half of which were dry holes.

In the first nine months of 1943, the greatest activity in the Illinois Basin has been in the following fields:

In Clay County: Bible Grove has increased from 32 producing wells on January 1 to 83 on September 1; Iola from 6 wells to 58; Sailor Springs from 36 wells to 57; Clay City (Clay and Wayne Counties) 688 to 716. Gallatin County: East Inman, 58 to 71; West Inman 5 to 21. Hamilton County: Blairsville 10 to 21; Dale-Hoodville 356 to 372; Rural Hill 171 to 190; Walpool 40 to 59. Jefferson County: King, 5 wells to 23; Woodlawn 148 to 159; Richland County: Noble 265 wells to 280; Wabash County: Mt. Carmel 194 wells to 209. Wayne County: Covington 32 to 41; Mt. Erie 11 to 18. White County: New Harmony 704 to 719.

The number of producing wells in some of the older fields declined in the course of the 9 months, for example, Marion County: Centralia 748 wells to 708. Franklin County: Thompsonville 15 wells to 10. Wabash County: Keensburg 319 wells to 316.

Only four wildcats were started in the past week out of 40 new operations reported. The wildcats were Nash Redwine 1 Howard & Casey, SE SW NE 6-3s-3e, Jefferson County; Continental Oil Co. 1 G. P. Hanna B, SE NW NW 29-5s-10e, White County; Bell Bros. 1 Indian National Bank, E½ NE NE 24-1s-3e, Jefferson County, and G. A. Morris 1 Munier, SE SE NW 27-1s-8w, St. Clair County.

ILLINOIS WILDCAT COMPLETIONS

Cumberland County: National Consumers 1 Stevens, E½ NE SW 8-9n-9e, dry at 2,675 ft. Golconda 2,251 ft., Cypress 2,300 ft., Paint Creek lime 2,430 ft., Benoist 2,460 ft., Benoist sand 2,485 ft., Ste. Genevieve 2,530 ft., Rosiclare 2,555 ft., Fredonia 2,570 ft.

Edwards County: Deep Oil 1 E. Sutton, S½ NW SW 33-2s-10e, flowed 416 bbl. of oil and 57 bbl. of water. McClosky lime 3,331-37 ft. Opens a pool.

Jackson County: Glen Cole 1 Heiple, NW SE NW 10-8s-1w, dry at 2,352 ft. Aux Vases at 2,108-45 ft.

Jasper County: Tide Water 1 Eubanks, SE SW NE 5-8n-9e, dry at 2,852 ft. Glen Dean 2,292 ft., Golconda 2,346 ft., Barlow 2,418 ft., Cypress 2,464 ft., Paint Creek 2,555 ft., Benoist 2,607 ft., Aux Vases 2,663 ft., Ste. Genevieve 2,701 ft., Rosiclare 2,715 ft., Fredonia 2,726 ft., McClosky 2,732-34 ft.

Lawrence County: S. A. Pearce 1 Ross Goodwin, NE cor. SW SE NW 28-5n-10w, dry at 1,715 ft. Barlow 1,285 ft., Cypress 1,310 ft., Renault 1,455 ft., Aux Vases 1,515 ft., McClosky 1,535-40, 1,555-70, 1,579-96 and 1,645-55 ft.

Macoupin County: W. L. Topf 1 Beasley and Way, SE SE NW 2-12n-6w, dry at 731 ft., St. Louis lime top at 730 ft.

Richland County: Sohio 1 E. Heap et al, SW SW SW 19-3n-11e, dry at 3,309 ft. Vienna 2,557 ft., Tar Springs 2,574 ft., lower Glen Dean 2,669 ft., Hardinsburg 2,689 ft., Golconda 2,745 ft., Barlow 2,832 ft., Cypress 2,891 ft., Paint Creek 2,995 ft., Benoist 3,047 ft., upper Renault 3,071 ft., Aux Vases 3,150 ft., Ste. Genevieve 3,190 ft., Fredonia 3,229 ft., McClosky 3,232 ft.

Shelby County: Holbert & Heath 1 Carnes, NW NE NW 35-11n-4e, dry at 2,041 ft. Glen Dean 1,530 ft., Barlow 1,639 ft., Cypress 1,688 ft., Paint Creek 1,753 ft., Paint Creek sand 1,777 ft., Renault 1,899 ft., Aux Vases 1,911 ft., Ste. Genevieve 1,952 ft., Fredonia 1,981 ft., no McClosky lime.

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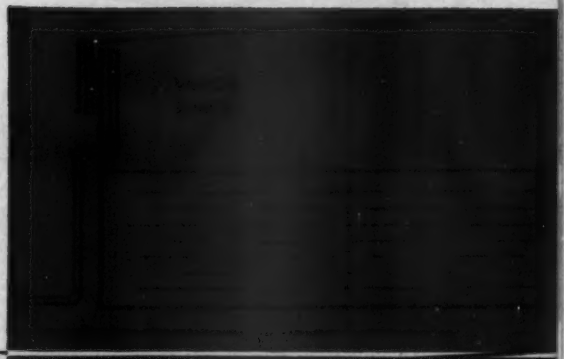

● However, if the temperature rises, the expanding vapors must be taken care of. This diagram shows the relative position of the Expansion Roof under these conditions. Instead of permitting the expanding vapors to be forced out, the Expansion Roof rises due to the pressure created by these vapors, providing ample space. Being oil sealed, no vapors can escape.

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● The vapor spaces of several cone roof tanks can be manifolded to the vapor space of a single Graver Expansion Roof tank of suitable size. In this way, complete protection is afforded to an entire battery with but one Expansion Roof installation. This method of manifolding applies with equal efficiency to both refinery units and terminal operations.

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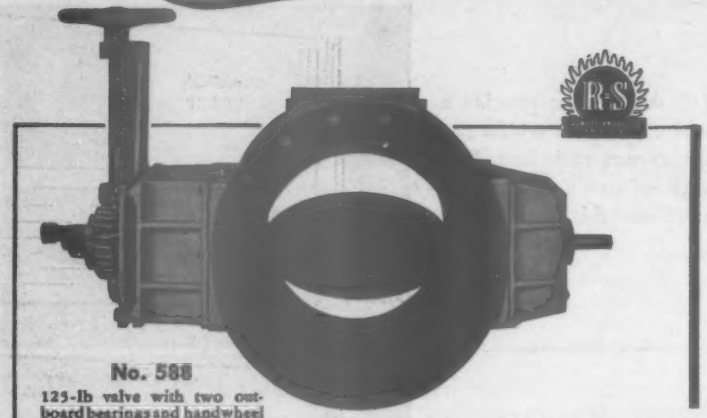

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The beveled vane seats at an angle against the valve body and tends to close itself under a pressure drop. Four to six revolutions of the hand wheel completely open or close the valve vane—that's double-quick action. Manually or power operated under pressures up to 900 pounds and from extremely high temperatures to sub-zero refrigeration conditions. R-S Butterfly Valves meet today's need for non-complicated construction, simplified operation and lower over-all costs. Write for detailed specifications.

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R-S Streamlined BUTTERFLY VALVES

EASTERN TEXAS

New Paluxy Sand Area Opened in Wood County

DALLAS, Tex.—Shell Oil Co. 1 M. C. Shepherd, John Polk Survey, 2,000 ft. southeast of producing wells in the Manziel Pool of Wood County, but separated from them by a dry hole drilled to 6,503 ft., has been reworked and successfully completed as a producer. The well was started originally as a Smackover test, but drilled to 6,697 ft., passing a good show in the Paluxy, and was plugged back to 6,404 ft. and casing was perforated with 52 shots from 6,378-88 ft. and the hole washed with 250 bbl. oil. The well flowed a small stream of oil, but would not flow steadily. A pumping unit was installed, and on potential test, the well pumped 208.3 bbl. 25-gravity oil in 24 hours, with a very small per cent basic sediment and water.

Cherokee County.—T. G. Shaw Oil Corp. 2 P. J. Bowling, wildcat in W. H. Walters Survey, 2½ miles southeast of Lone Star, total depth 3,993 ft., set 2-in. tubing at 3,985 ft. and washed and flowed about 40 bbl. fluid, of which 20 per cent was oil.

Franklin County.—Tide Water Associated Oil Co. and Seaboard Oil Co. 1 G. L. Gilbert, ⅜ mile north of the New Hope field discovery from Rodessa and Travis Peak formations, assured an extension to the field when it flowed 47 bbl. in 4 hours

LEGAL

U. S. DEPARTMENT OF THE INTERIOR, General Land Office, District Land Office, Cheyenne, Wyoming. Notice is hereby given that the lands herein described within the known geologic structure of the East Lance Creek oil and gas field, Wyoming, are offered to qualified bidders of the highest amounts offered per acre as a bonus for the privilege of leasing the land under section 17 of the leasing act as amended by the act of August 21, 1935 (49 Stat. 674, 30 U. S. C. 226) at a sale to be held in the District Land Office at Cheyenne, Wyoming, at 10 a.m. on October 14, 1943, in the following units: Parcel No. 1, T. 36 N., R. 64 W., sec. 28, W½SE¼; Parcel No. 2, T. 36 N., R. 64 W., sec. 29, E½ SE¼. Each lease will be made subject to the unit plan for the East Lance Creek Unit Area, Wyoming, approved March 2, 1936. Each successful bidder must deposit on date of sale with the officer in charge of the sale a certified check or cash for one-fifth of the amount bid by him and file a showing of qualifications to receive a lease as required by section 7 of Circular 1386. The remainder of the bonus bid and annual rental at the rate of $1 per acre must be paid and a $5,000 corporate surety bond must be furnished prior to the issuance of the lease. Each parcel will be offered for sale separately. In the even the same bidder is the successful bidder on both parcels, he may consolidate them into a single lease since the total acreage does not exceed 640 acres. Bids may also be submitted by mail provided they are accompanied by one-fifth of the bonus bid and a showing of qualifications of the bidder. The envelope must be plainly marked for opening on the day and hour of the sale. Bidders are warned against violation of section 50, United States Criminal Code, approved March 4, 1909, prohibiting unlawful combination or intimidation of bidders. The right is reserved to reject any and all bids in the discretion of the Secretary of the Interior. William G. Johnson, Register.

with ¼-in. choke on bottom through 96 perforations from 7,295-7,311 ft., the Rodessa zone. A test was being made of the Travis Peak zone from 7,914-8,055 ft., total depth.

EAST TEXAS WILDCAT COMPLETIONS

Anderson County: Carter-Gragg Oil 1 Nannie Jaramillo, 500 ft. from S&W, NW 40-ac. of 333-ac. tract or 2,775 ft. from W, 5,450 ft. from S lines Eliz. Groce Sur., elev. 614 ft., Austin 4,903 ft., Eagleford 5,263 ft., Woodbine 5,634 ft., dry, T.D. 5,675 ft.

Houston County: Continental Oil 1 Leo Knox, 330 ft. from N and SE lines 54-ac. tract, 1,840 ft. from NW, 2,200 ft. from N'ly NE line Burrell Morris Sur., elev. 255 ft., dry, T.D. 5,232 ft.

APPALACHIAN FIELDS

Oriskany Gas Fields Showing Steady Decline

PITTSBURGH, Pa.—The decline of Oriskany gas fields in Elk and Poca districts, Kanawha County, and in Jackson County to the north presents a serious problem in replacing the billions of feet of gas which those fields yielded with other new fields. The deep drilling or lower Devonian tests has not shown any new fields of comparable size and the little new which has been developed is barely on the commercial size border. Drilling is again reverting to additional wells in proven fields and all the reserves are again being drilled. Tucker County on the eastern Appalachian frontier is being tested in Dry Fork district but the test has

LEGAL

U.S. DEPARTMENT OF THE INTERIOR District Land Office, Cheyenne, Wyoming Notice is hereby given that the lands herein described within the known geologic structure of the Boone Dome gas field, Wyoming, are offered to qualified bidders of the highest amounts offered per acre as a bonus for the privilege of leasing the land under section 17 of the leasing act, as amended by the act of August 21, 1935 (49 Stat. 674, 30 U.S.C. 226), at a sale to be held in the district land office at Cheyenne Wyoming, at 10 o'clock a.m. on September 30, 1943, of the following parcels: Parcel No. 1, T. 35 N., R. 85 W., sec. 9, NE¼NE¼ N½NW¼, SE¼ NW¼, E½SW¼, W½SE¼ SE¼SE¼; sec. 10, SW¼NW¼, NW¼SE¼ SE¼SE¼; Parcel No. 2, T. 35 N., R. 85 W., sec. 14, W½NW¼, SW¼; sec. 15, E½NE¼ N½SW¼, SE¼SW¼, S½SE¼. Each successful bidder must deposit on the date of the sale a certified check or cash for one-fifth of the amount bid by him, and file a showing of qualifications to receive the lease as required by section 7 of Circular 1386. The remainder of the bonus bid and the annual rental at the rate of $1 per acre must be paid and a $5,000 corporate surety bond must be furnished prior to the issuance of the lease. Each parcel will be offered for sale separately. In the event one bidder is awarded both parcels, a collective bond in sufficient amount may be furnished to cover the two leases he obtains. Bids may be submitted by mail provided they are accompanied by one-fifth of the bonus bid and a showing of qualifications of the bidder. The envelopes should be plainly marked for opening on the day and hour of the sale. The bidders are warned against violation of the provisions of section 59 of the United States Criminal Code, approved March 4, 1909, prohibiting unlawful combination or intimidation of bidders. The right is reserved to reject any and all bids at the discretion of the Secretary of the Interior William G. Johnson, Register.

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been held up with a bad fishing job at 7,744 ft., a point just below the Burkett shale with the lower Devonian still to be reached. In Gilmer County, a deep test in Center district, is drilling at 5,555 ft. but it also is above the lower Devonian markers. In Boone County, a test is drilling below the top of the white Medina which was dry and another is starting. The Oriskany and Newburg is producing gas but the wells are small. No other deep work is under way.

OHIO, KENTUCKY

New Pennsylvania Grade Pool in Muskingum County

ZANESVILLE, Ohio.—A new oil pool was opened up 2 miles southeast of Zanesville by the Preston Oil completion on the Maria Schneider tract in Section 13, Wayne Township, Muskingum County. The well flowed 171 bbl. Pennsylvania-grade oil from the Clinton sand at 3,766-3,795 ft. The pool is expected to trend to the southwest and have an estimated reserve of 600,000 bbl.

An oil pool 2½ miles northwest of the Clayton pool is indicated by the Industrial Gas completion on the John Stalter tract in Section 34, Hopewell Township, Perry County. The well made 80 bbl. from the Clinton sand at 2,894-2,924 ft. An offset to the north will be drilled to further test the area.

WILDCAT COMPLETIONS

Fairfield County, Richland Township: Ohio Fuel 1 A. L. Saum, Sec. 8, Clinton, 2,585-2,606 ft., dry, T.D. 2,630 ft.

Muskingum County, Wayne Township: Preston Oil 1 Maria Schneider, Sec. 13, Clinton 3,766-3,795 ft., 171 bbl., T.D. 3,825 ft.

INDIANA

EVANSVILLE, Ind.—Two oil wells and three dry holes were completed in Indiana during the week, all but one in established fields. One of the failures was a wildcat in Vanderburg County.

INDIANA WILDCAT COMPLETIONS

Vanderburg County: Cherry & Kidd 1 Sensmeier, C SE SE 2-5s-11e, dry at 2,566 ft. Menard 1,503 ft., lower Menard 1,560 ft., Glen Dean 1,767 ft., Hardinsburg 1,798 ft., Barlow 2,073 ft., Paint Creek 2,183 ft., Renault 2,295 ft., Ste. Genevieve 2,383 ft., no McClosky lime.

WESTERN KENTUCKY

OWENSBORO, Ky.—The best of Western Kentucky completions during the week was a 410-bbl. well in Henderson County, Cherry & Kidd and Frontier Oil Co. 14 C. D. Burbank, producing from Cypress sand at 2,295-2,300 ft., the total depth. In Union County Benedum & Trees have a promising well in 1 City Property, west of Uniontown, which was swabbing about 50 bbl. a day from Waltersburg sand at 1,703-28 ft.

WESTERN KENTUCKY WILDCAT COMPLETIONS

Webster County: Mid-Continent 1 J. L. Minor, 2¼ mi. of Sebree, dry at 2,739 ft., Menard 1,663 and 1,750 ft., lower Glen Dean 1,961 ft., Barlow 2,209 ft., Ste. Genevieve 2,499 ft.

White et al 1 H. Z. Clark, near Clay, swabbed 76 bbl. Palestine sand 1,227-33 ft. and 1,242-1,246 ft. Shot. T.D. 1,248 ft.

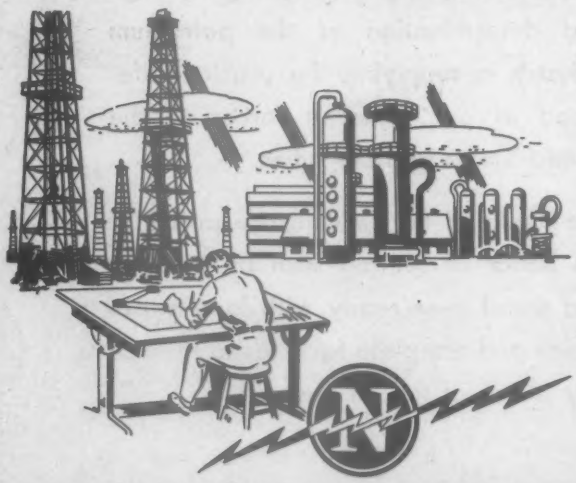
EASTERN KENTUCKY

ASHLAND, Ky.—Two completions and a dry hole were included in the report of drilling operations in Eastern Kentucky this week. Three new locations were reported, all in previously-proven areas.

Kentucky-West Virginia Gas Co. completed well 5470, J. H. Akers, Little Mud Creek, Floyd County, at total depth of 1,331 ft., Salt sand, with open flow 735,000 cu. ft. daily.

The same company completed well 5474 A. C. Wells, Daniels Creek, Johnson County, at total depth of 2,418 ft., shale, with open flow of 207,000 cu. ft. gas daily, A.S.

The same company hit a dry hole in well 5455 Allen Maynard, Raccoon Creek, Pike County, at total depth of 3,325 ft.



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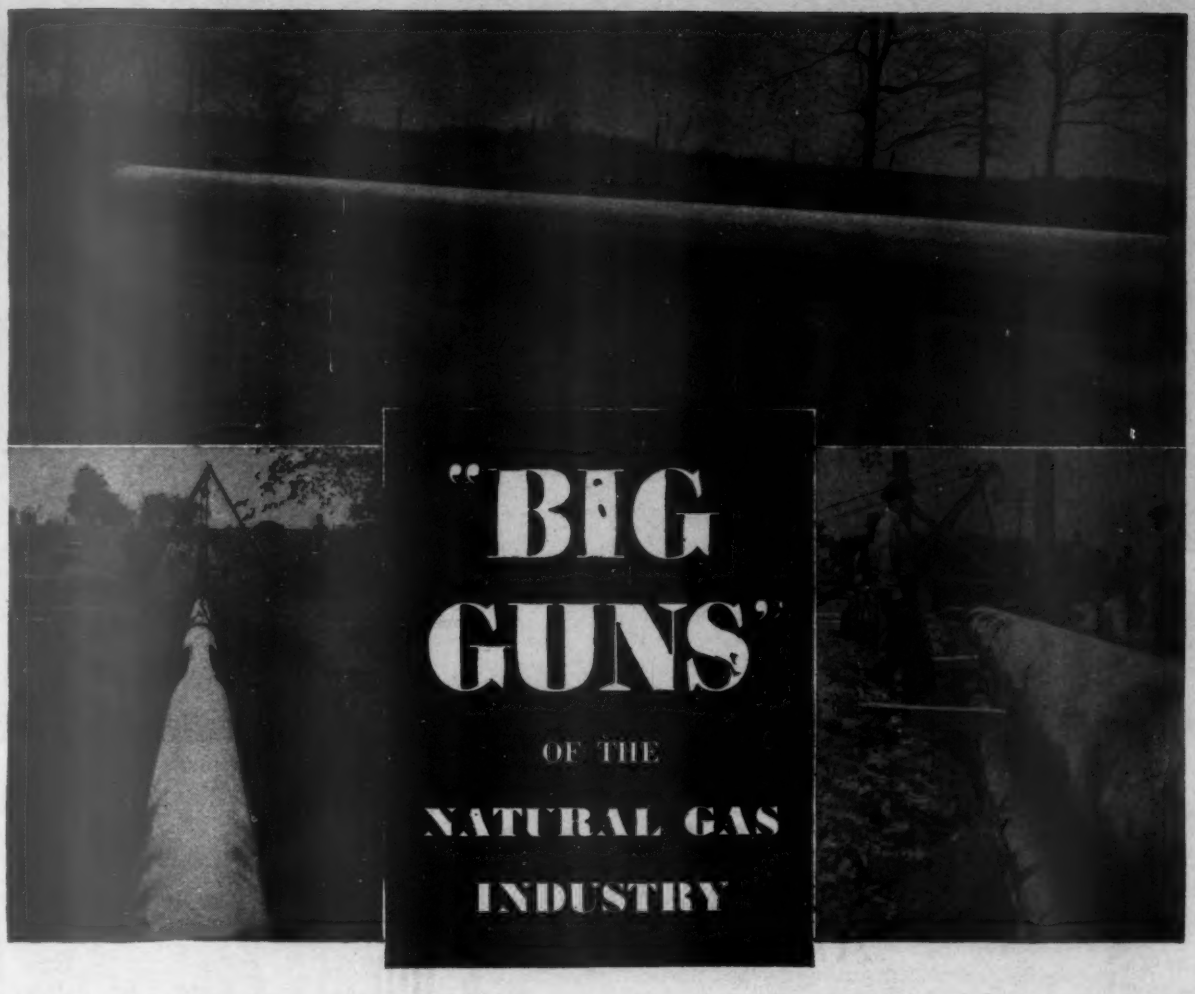

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Columbia System is now supplying more Natural Gas for industrial use than ever before in its history.

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Great banks, like pipe lines, are arteries of credit and commerce, serving the people, business and government. Today, more than ever, America's banks are furnishing the service so necessary to industry and to the nation at war. And today, more than ever, the services of the National Bank of Tulsa are being constantly adjusted and expanded to meet the growing needs of the Petroleum industry and the nation to which oil is so vital.

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The Oil Bank of America

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MICHIGAN

Offset to Hatton Discovery Is Dry

SAGINAW, Mich.—Completed as a dry hole, the first offset test to the Ranch Oil Co.'s big wildcat, brought in in midsummer in Hatton Township, Clare County, chilled hopes for a new Michigan crude source. Drilling halted at 4,030 ft. on the test, the Rowmor-Leonard-Gordon 1 Oxendale, in 31-18n-4w. Several other tests are in progress in the area.

Of 17 oil and gas test completions in Michigan last week, 11 were dry holes, 7 of them being wildcat explorations. One more gas producer was developed and initial production from the five new oil producers ranged from 5 bbl. a day in one deep test, 12 bbl. a day in another, to a flow gaged at 750 bbl. pinched from another good well in the Goodwell Township, Newaygo County, district. Other production resulted from a 100-bbl. well in Bay County's Kawkawlin field and a 100-bbl. completion in Bangor, Van Buren County.

WILDCAT COMPLETIONS

Gratiot County, Sevilie Township: Freeman Oil Co. 1 Bertha Hart, C S½ SE SE 5-12n-4w, dry, T.D. 3,617 ft.

Mecosta County, Wheatland Township: Southwest Development Co. 1 Hewlett, NE NE NW 26-14n-7w, dry, T.D. 1,635 ft.

Osceola County, Hartwick Township: Robert Bond and Eugene Hilliard 1 State, C W½ NE NE 1-19n-8w, dry, T. D. 4,226 ft. Hersey Township: C. L. Maguire, Inc.-D. E. Hughes 1 McIntyre-White, C S½ NW SW 1-17n-9w, dry, T.D. 1,393 ft. Rose Lake Township: Rowmor Corp. et al 1 Gay Ranch, C W½ NE NE 1-19n-9w, dry, T.D. 4,116 ft.

Ottawa County, Holland Township: Southwest Development Co. 1 Morren, SW NW SE 2-5n-15w, dry, T.D. 1,681 ft.

Van Buren County, Geneva Township.

LEGAL

U. S. DEPARTMENT OF THE INTERIOR. General Land Office, District Land Office, Cheyenne, Wyoming. Notice is hereby given that the N½NW¼ sec. 14, T. 26 N., R. 90 W., 6th P.M., 80 acres, Lost Soldier oil and gas field, Wyoming, is offered to the responsible qualified bidder of the highest bonus per acre for lease under section 17 of the leasing act as amended by the act of August 21, 1935 (49 Stat. 674, 30 U. S. C. 226) at a sale to be held in the District Land Office at Cheyenne, Wyoming, at 10 a.m. on September 30, 1943. The land will be offered in a single unit. The successful bidder must deposit on the date of sale with the officer in charge of the sale a certified check or cash for one-fifth of the amount bid and the showing of qualifications to receive a lease required by section 7 of Circular 1386. The remainder of the bonus bid and the annual rental at the rate of $1 per acre must be paid and a $5,000 corporate surety bond must be furnished prior to the issuance of the lease. Bids may also be submitted by mail provided they are accompanied by one-fifth of the bonus bid and a showing of qualifications of the bidder. The envelope must be plainly marked for opening on the day and hour of the sale. Bidders are warned against violation of section 50, U. S. Criminal Code, approved March 4, 1909, prohibiting unlawful combination or intimidation of bidders. The right is reserved to reject any and all bids in the discretion of the Secretary of the Interior William G Johnson, Register.

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Sun Oil Co. drilled the 1 Goodrich in Section 32, Winterfield-Clare to 5,123 ft. to complete as a 12-bbl. producer. The smaller one, McClanahan Oil Co. 1 Pure-State, in Section 29 of Richfield, Roscommon County, was drilled to 4,189 ft.

Drilling permits issued by the state Conservation Department kept pace with completions as 18 were granted for exploration in 10 counties, bringing the year's total to 415. Four permits are for Van Buren County, shallow-drilling tests, three each to Mecosta and Osceola, two for Clare, one each for Saginaw, Allegan, Bay, Ottawa, Missaukee and Newaygo.

ROCKY MOUNTAIN

Crest Well at Elk Basin Finds No Gas Cap

DENVER, Colo.—The Elk Basin field in the Wyoming Big Horn Basin, which will be called upon to supply a large part of the crude for the projected Stanolind Pipe Line Co. line from the field to Salt Creek, had three completions this week aggregating 8,400 bbl. initial production. The one of the group of special interest was Continental Oil Co. 101 E-T Elk-2, that company's first Tensleep well in the field. It is the "top" well on the structure, and came in for 100 bbl. an hour, proving the absence of a gas cap. The Tensleep was encountered 645 ft. above sea level as against 962 ft. below sea level in the Mule Creek Oil Co. 1 Watson, the lowest well structurally in the field, the difference in elevation being 1,607 ft.

Since the Tensleep discovery was completed last December by the Minnelusa Oil Corp., 15 wells have been completed, including the discovery, in that horizon. Their aggregate initial production was 29,200 bbl. daily, an average of 1,950 bbl. per well. The completions, by companies, with aggregate initial production are as follows: Minnelusa Oil Corp., 4 wells, 7,800 bbl.; Ohio Oil Co., 5 wells, 8,260 bbl.; Mackinnie Oil & Drilling Co., 1 well, 1,500 bbl.; Mule Creek Oil Co., 1 well, 1,440 bbl.; Stanolind Oil & Gas Co., 3 wells, 7,800 bbl.; Continental Oil Co., 1 well, 2,400 bbl.

So far no failures have occurred, and it is estimated that there will be around 4,500 acres productive as shown by the wells so far drilled. Operators estimate that the field will have a settled production of at least 15,000 bbl. daily by next spring. That takes into consideration not only the normal decline in flush production, but the flowing of the wells at less than capacity to conserve pressure and avoid water intrusion. Some of the initial production figures given above are based on the flow through chokes on tubing and do not entirely represent capacity had they been allowed to flow open. Seventeen wells are drilling at present. These are distributed as follows: Minnelusa, 3; Mackinnie, 1; Stanolind, 2; Ohio, 9; Continental, 1; Mule Creek, 1.

Deep test at Horse Creek. — The General Petroleum Corp. has abandoned its 32 Government, SW NE NW 32-17n-68w, Horse Creek structure, Laramie County, Wyoming, on the northwest rim of the Denver Basin, at 5,383 ft., after finding it ran 240 ft. lower than the discovery well ¾ mile to the south. It had the top of the Lakota at 5,369 ft. This was intended as a deep test to the Tensleep horizon, but upon finding it ran low, rig will be moved back to the discovery, which will drill deeper from 5,530 ft. The discovery came in a year ago for 500 bbl. per day in the Lakota, but subsequently went to water. After drilling a test ½ mile south, which was a small well in the Muddy sand, it went back to the discovery and reconditioned it. For a while it made 250 to 300 bbl. per day, but recently turned again to water.

Another test for Canyon Creek.— Weststates Petroleum Corp., of California, has released location for a second test on the Canyon Creek structure, Sweetwater County, Wyoming, just north of the Colorado line, in its 2 Horne, C NW 11-12n-101w. It is located on a block of 12,000 acres as-

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sembled by C. S. (Red) Hill, of Denver, ¾ mile northeast of the discovery well drilled by that company in 1941 which went to 3,900 ft. and plugged back and completed for 1,500,000 cu. ft. of gas in a sand in the Wasatch at 2,688-2,710 ft. The new operation will go to 4,500-5,000 ft. and test the horizons in the Tertiary productive at Hiawatha and Powder Wash.

SOUTHWEST TEXAS

Wildcatting Spurts In Southern Sector

CORPUS CHRISTI, Tex. — Modest pickup in drilling operations was observable in the Southwest Texas territory this week, including a generous proportion of wildcats. In the South Texas area alone 25 new locations and first reports were announced. Two new wildcat locations have been staked in De Witt County. Arkansas Fuel Oil Co. has spotted 1 William Buehrig, 3½ miles northwest of Meyersville and Continental Oil Co. has staked 1 F. Wendle, ¾ mile south of Meyersville. In Jim Wells County Smith & Mosser have spotted 1 Pablo Perez, 2 miles north of Alice. In Karnes County Arkansas Fuel Oil Co. will drill 1 E. E. Lyons, 2½ miles south of Runge. Tom Graham has staked location for 1 T. Graham, 3 miles northeast of Banquette. Barnsdall Oil Co. has spotted 1 Mitchell, in the P. Benavides Survey of Victoria County. Baldridge & King have derrick material on the ground for 1 W. P. Lincoln, 12 miles southeast of Willamar, in Willacy County. Hewitt & Dougherty have derrick up for 1 C. Dubose, 3 miles southwest of Pawnee. Winsor Oil Co. has pits dug for 1 J. McNeel, 20½ miles south of Zella, in La Salle County. F. M. Gunther has spudded 1 W. Z. Berry, 5 miles northwest of McElroy, in Travis County. W. T. Montgomery was at 990 ft. in the Del Rio at 1 Montgomery fee, 5 miles northeast of Lacoste, Bexar County. J. C. Renfro was making hole at 785 ft. at 1 Banowski, 4 miles northwest of Viejo Creek, Kimble County.

SOUTH TEXAS WILDCAT COMPLETIONS

Live Oak County: Argo Oil Corp. 1 J. Schwartz, 4½ mi. NE of Mt. Lucas, dry at 4,572 ft.

Zapata County: Texas 2 B. Hartman, 5 mi. W of Guerra, 871,000 cu. ft. gas through ¼-in. choke, T.P. 950 lb. flowing, 642 lb. shut in, S.I. C.P. 670 lb., perf. 1,941-46 ft., T.D. 2,312 ft. Gas discovery.

LOWER GULF COAST WILDCAT

Bee County: W. E. Rowe 1 Ben Mattingly, 4 m. NW of Skidmore, dry at 4,755 ft.

Hidalgo County: Seaboard 2 Boston-Texas Land Trust Co., 5 mi. E of Rincon field, dry at 6,100 ft.

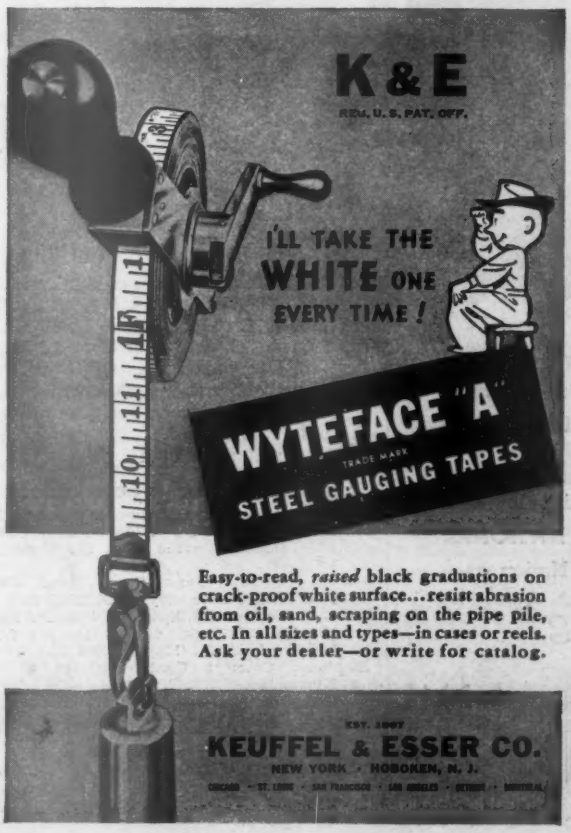
Victoria County: Edwin Neilson et al 1 J. W. Ragsdale, 5½ mi. SE of Inez, dry at 6,765 ft.

LOUISIANA GULF

Big Lake, Cameron Parish Discovery Makes Good Flow

NEW ORLEANS, La.—Continental Oil Co. has a well in its 1 Hebert, in the Big Lake area of Cameron County. This test, which was projected to go to 12,000 ft., but went to 13,084 ft. and was plugged back to 8,591 ft., was swabbed in, with perforations at 8,571-86 ft. and packer at 8,551 ft. In the first 20 hours it flowed 146 bbl. of 39.7-gravity oil, through 10/64-in. choke for 4 hours and ⅛-in. choke for 16 hours. Tubing pressure was 2,700 lb. and gas-oil ratio 5,900. Testing continued.

What manner of well would eventuate at the 1 Hattie Haas, Danciger Oil & Refining Co. wildcat test in the Reddell area of Evangeline Parish, was still a question this week. On the latest drill-stem test, covering 5½ hours, the testing tool was on the 2½-in. tubing, with packer at 11,998 ft., ⅜-in. choke at bottom, ⅞-in. choke at top, and using 30 stands of water cushion. Perforations were at 12,048-56 ft. The test showed no working pressure. It recovered fresh water, salt water, mud and a little gas and distillate. Preparations were made to squeeze the per-



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forations, reperforate at a higher level, and make another drill-stem test. In one of a series of tests made last month this wildcat flowed at the rate of 72 bbl. of 51-gravity distillate daily. Another Reddell area wildcat, Continental and Humble Oil & Refining Co. 3 Pardee Lumber Co., ran an electrical survey from 10,012 to 2,024 ft. No show was reported, and at the end of the week the well was drilling at 10,240 ft. in shale. Upon completion of the Hattie Haas, Danciger will move the rig to location staked for 1 Bowman-Hicks Lumber Co., projected Wilcox test in the Beaver Creek area of Evangeline Parish.

OKLAHOMA

Oklahoma County Wildcat Has Show of Oil in Hunton

CONSIDERABLE interest is shown in the wildcat being drilled by Stanolind Oil & Gas Co. at 1 Johnson, NW SW NE 9-13n-1e. A drill-stem test in Hunton lime at 5,547-59 ft. recovered 224 ft. of oil and 20 ft. of mud. At last report, operators were drilling below 5,630 ft. in Sylvan shale. Location is about 3 miles north of the Jones pool which produces in the Cleveland sand at around 4,800 ft. The deepest test here has been to the second Wilcox at 5,998 ft.

Pottawatomie County. — In the southwestern part of the county, 3 miles west of the town of Wanette, Cities Service Oil Co. 1 Lamirand, NE SE SW 27-6n-2e, was put on the pump after swabbing and flowing 103 bbl. of oil in 7 hours. The well was drilled to 5,304 ft., plugged back to 5,220 ft. where it made a hole full of water. Another plug back to 5,180 ft. and two acid treatments at 5,118-30 ft. resulted in the flow of oil.

Creek County.—In the southwestern edge of the Manford district L. B. Jackson 1 Childers, SE SE SW 32-18n-9e, was showing for a small gas well. Total depth was 2,341 ft. It made an estimated 4,000,000 cu. ft. of gas at 1,000 lb. rock pressure when the plug was drilled in the Red Fork sand topped at 2,306 ft.

OKLAHOMA WILDCAT COMPLETIONS

Lincoln County: Creekmore-Rooney 1 Jones, NE SW SW 1-16n-2e, dry, T.D. 4,636 ft., Bartlesville 4,338 ft., Hunton 4,612 ft.

Marshall County: Texas Co. 1 Beard, SW NW NW 30-8s-6e, dry, T.D. 2,056 ft.

Pawnee County: Phillips Pet. 1 Robe, NE NE NW 26-23n-8e, dry, T.D. 3,103 ft., Layton 1,950 ft., Mayes 3,078 ft.

Stephens County: Continental et al 1 Kincannon, SW NW SE 14-1n-6w, dry, T.D. 3,022 ft., P.B. 2,450 ft., estimated 2,000,000 cu. ft. gas, P.B. 2,398 ft. and gas decreased to 500,000 cu. ft., filled with water.

Washita County: Gulf 1 Perkins, SE SW 31-8n-17w, dry, T.D. 4,714 ft., Hunton 2,020 ft., Viola 3,596 ft., show heavy oil 3,780 ft.

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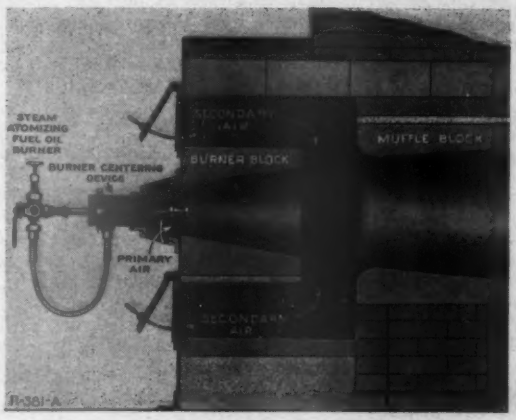

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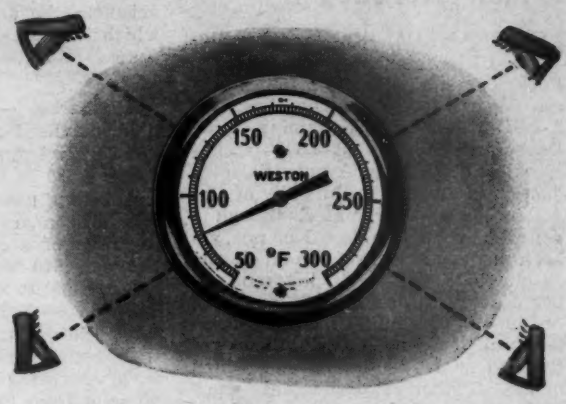

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ALL-METAL TEMPERATURE GAUGES

CANADIAN FIELDS

Devonian Production Found In Ram River Area

CHATHAM, Ont.—In the Ram River-Clearwater area, west of the Rocky Mountain House, in the northern Alberta foothills, Ram River Oils 2, LSD 8, 1-37-11w5, bottoming in the Devonian limestone at 4,340 ft., has completed acidizing. A potential production of around 33 bbl. daily of 40.1 A.P.I. crude is estimated, though a definite production test has not yet been made. Analysis of the oil shows: gasoline, 37 per cent; kerosene, 23 per cent: lubricating oil, 35 per cent; residue, 5 per cent, including 0.035 per cent of sulfur. The test hole was finished with 1.96-in. casing, which makes further experimental work difficult, but it is believed to have demonstrated the existence of a high-pressure zone. A considerable gas flow was encountered with the oil.

A report by Denton & Spencer, engineers, of Calgary, points out the low temperature of the crude brought to the surface with the swab from 4,000 ft. depth. Though the oil was lifted in less than 7 minutes, temperatures as low as 45° were found. This is attributed to the effect of gas expanding in its passage from a high pressure to a low-pressure zone. When the producing horizon was penetrated, free oil actually entered the hole against the hydrostatic head of the drilling fluid with a pressure estimated in excess of 1,850 lb. It is thought probable that a high-pressure zone exists in the area of the well, from which the mixture of oil and gas passes into the hole through small crevices.

Athabaska. — In the Athabaska field, northern Alberta, Deca 1, LSD 1, 4-66-22w4, has cored from 1,338 to below 1,380 ft. in a sand showing oil and heavy gas. Production tests of this horizon are being made, following tests of a gas flow encountered between 610 and 620 ft. The well logged 300 ft. higher than Deca 2, LSD 3, 16-66-23w4, which encountered the Grand Rapids sandstone with heavy gas production at 1,670 ft. after coring a heavily saturated oil sand from 1,654 to 1,663 ft.

Taber.—In the Taber field, southern Alberta, Imperial-Clancey 1 is coring below 3,110 ft. and has recovered oil-saturated cores. Production casing has been run and the hole will be drilled in for a test. Mid-Continent Oil 1, LSD 10, 12-8-17w4, and Mid-Continent 2, LSD 14, 24-6-15w4, have spudded. Dominion Oils 57-18-B, LSD 5, 17-9-16w4, finished at 3,184 ft., with indicated production around 50 bbl. daily, has installed pump for a production test.

KANSAS

Barton County Wildcat Extends Albert-Otis

ON the southeast flank of the Albert-Otis area Shirley Clum et al 1 Bahr, N½ NE SW 26-18-15w, was drilled to 3,506 ft. with pay at 3,496-3,503 ft. The well made a number of flowing tests of from 3 to 10 bbl. an hour. On pumping tests it made 101 bbl. in 17 hours and 139 bbl. in 24 hours. Later it pumped 75 bbl. of oil in 1 hour. Gravity was 37.3°.

Graham County.—Southwest of the Morel pool, Hollow Drilling Co. 1 Fesler, NW NW NW 25-9-21w, was completed as a pool opener. Initial potential was given as 1,904 bbl. a day in Arbuckle lime at 3,766 ft. After rigging up standard tools and drilling plug to bottom, the hole filled 850 ft. with oil in 3½ hours. This was swabbed out and it filled 1,070 ft. in 5 hours. After acid treatment there was 2,600 ft. of oil in the hole and it swabbed 28 bbl. in 35 minutes, 1,400 ft. off bottom. Gravity was 26.11 corrected. There was no water with the oil.

KANSAS WILDCAT COMPLETIONS

Cowley County: Phillips Pet. 1 Mabee, NW SE NE 24-31-3e, dry, T.D. 3,393 ft., Arbuckle 3,384 ft.
Harvey County: Derby and Sunray 1 Web-

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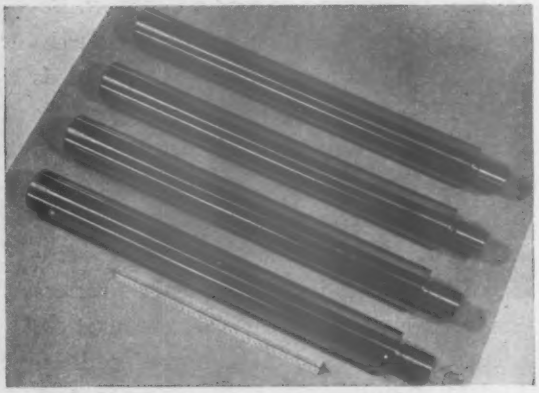

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ster, SE SE SE 15-24-2e, dry, T.D. 3,995 ft., Viola 3,842 ft., Arbuckle 3,942 ft.

Lincoln County: Bird, Handley & Sheedy 1 Paull, SW NE SW 36-13-7w, dry, T.D. 4,103 ft., Viola 3,834 ft., Arbuckle 4,058 ft.

Phillips County: Harbar Drlg. 1 Wheaton, SW SW SE 9-5-17w, dry, T.D. 3,610 ft., Lansing 3,095 ft., Simpson 3,510 ft., Arbuckle 3,560 ft., perforated 3,219-27 ft., acidized and filled 80 ft. with oil, ripped casing and filled 260 ft. with fluid, mostly water.

Rice County: Hollow Drlg. and National Ref. 1 Jennie Gill, E½ SW NE 15-19-10w, dry, T.D. 3,315 ft., Lansing 2,931 ft., Arbuckle 3,290 ft.

Stafford County: Texas Co. 1 Shepherd, SW SW NW 16-22-11w, dry, T.D. 3,662 ft., Viola 3,552 ft., Arbuckle 3,630 ft.

W. N. Bartlett 1 Kelly, S½ SE SE 35-23-12w, dry, T.D. 3,960 ft., Viola 3,742 ft., Arbuckle 3,922 ft.

Continental 1 Kirkpatrick, NE SW NW 31-24-12w, dry, T.D. 4,175 ft., Viola 3,991 ft., Arbuckle 4,160 ft.

MISSOURI

ST. JOSEPH, Mo.—O. R. Newcomer et al 1 Lasell, C NW SW NW 8-64n-39w, Atchison County, Missouri, was cleaning out after gun-perforating casing opposite the Bethany Falls limestone at 833 ft. An electrical log has revealed a showing of oil. Bob Miller was preparing to spud 1 J. H. Simpson, C NE SW 32-60n-37w, Holt County, Missouri, 4 miles east of Oregon.

Power Oil Co. will drill its fourth well in the Ogle pool near Dawson, Neb. Location has been staked for the company's 2 Bohrer, E½ SE NW 10-1n-14e, Richardson County, Nebraska. This will be an east offset to Power Oil Co. 1 Bohrer and a south offset to Nebraska Refining Co. 2 Bohrer. B. & T. Drilling Co. of Falls City has the contract.

NORTH LOUISIANA

Jackson Parish Wildcat Finds Show of Oil

SHREVEPORT, La.—Mid-Continent Petroleum Corp.'s wildcat, 1 Tremont Lumber Co., 31-15n-3w, set pipe at 7,443 ft. after drilling to total depth of 8,319 ft. Perforations and acid at 7,293-7,320 ft. resulted in a show of oil but later tested all water. At last report operators were squeezing to reperforate in another zone.

MISSISSIPPI

JACKSON, Miss.—Humble Oil & Refining Co. 1 J. A. Hurst, 33-5n-8w, Greene County, is reported to have encountered a showing of heavy black oil at 8,360-67 ft. and a show of gas at 8,410 ft. An electrical survey was run to 8,681 ft. The well was shut down for repairs at the weekend. It topped the Marine Tuscaloosa at 7,789 ft. Humble 1 Robinson Land & Lumber Co., 2-6n-7w, Wayne County, was drilling in shale at 6,682 ft.

Gulf Refining Co. 1 Aden Davis, 15 miles northeast of Laurel, in Wayne County, was flowing 6 bbl. of oil daily through 2½-in. tubing at total depth of 7,100 ft., and was waiting for standard rig. Gulf 1 W. J. Price, 19-7n-17w, Jefferson County, was dry at 2,538 ft. That company has spotted location for 1-A S. I. Lowry, 31-7n-13w, Jones County, and was drilling at 2,320 ft. in the caprock at another wildcat, 1 James A. Cox, 35-7n-10e, in Lawrence County. Gulf set 10¾-in. casing at 472 ft. at 1 G. S. Stanley, 36-10n-9w, Wayne County, and was waiting for cement to set.

William Helis et al ran an electrical survey from 10,511 ft. and took sidewall cores at 1 T. H. Dinkins, 28-5n-11e, Lawrence County. No shows were reported, and operator was drilling ahead at 10,655 ft. in shale. The California Co. was drilling at 10,890 ft. in shale at 1 Hettie Smith Unit, 4-7n-7e, Lincoln County.

MISSISSIPPI WILDCAT COMPLETIONS

Jefferson Davis County: Gulf Refining Co 1 W. J. Price, 19-7n-17w, dry at 2,538 ft.

ARKANSAS WILDCAT COMPLETION

Phillips County: John C. Liming 1 R. A. Watkins, NW SW 7-1s-3e, dry, T.D. 3,440 ft., Wilcox 1,200 ft., Nacatoch 3,100 ft.

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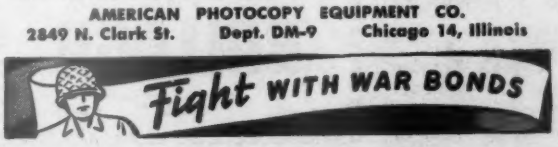
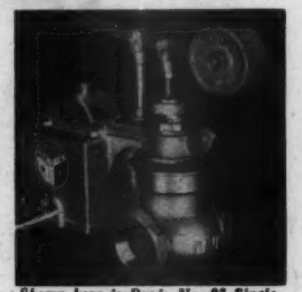


AUTOMATIC DISTANT CONTROL VALVE OPERATION

DAVIS SOLENOID VALVES



Shown here is Davis No. 93 Single-Seated, Pilot-Stem Solenoid Valve. Sizes ½" to 4", for gas, steam or liquid service.

STANDARD Davis solenoid valves are available for steam, air, gas, water, oil and viscous liquids in a range of sizes from 1½" to 12" and for pressures up to 1500 lbs. They can be operated by any device which will make or break an electric current. They may be either normally open or normally closed design. Solenoids can be housed in explosion proof boxes.

If you have a solenoid valve application, Davis engineers will be glad to give complete recommendations on the right valve for the job. Literature on request.

DAVIS REGULATOR COMPANY
2343 SOUTH WASHTENAW AVE. CHICAGO, ILL.

DISTRIBUTOR: Westcott & Greis, Inc., Tulsa, Dallas and Houston.

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Products include—Alloy Steels, Tool Steels, Stainless Steel, Hot Rolled Bars, Hoops and Bands, Heavy Structurals, Beams, Channels, Angles, Tees and Zees, Plates, Sheets, Cold Finished Shafting and Screw Stock, Strip Steel, Boiler Tubes, Mechanical Tubing, Rivets, Bolts, etc.

JOSEPH T. RYERSON & SON, INC.
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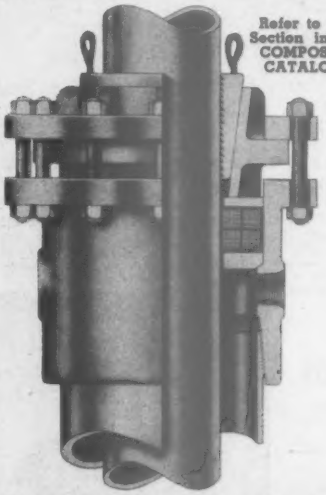
BREWSTER
CASING HEADS
Any Size, Pressure or Combination



Refer to our Section in the COMPOSITE CATALOG.

The BREWSTER CO., Inc.
Shreveport, Louisiana, U.S.A.
EXPORT:
Acme Well Supply Co., 19 Rector St., N. Y. C.

Brewster proudly flies the Army-Navy "E" Flag, awarded for high achievement in war production.

PIPE LINE REPAIR CLAMPS
EFFICIENT — ECONOMICAL
More than 45,000 sold

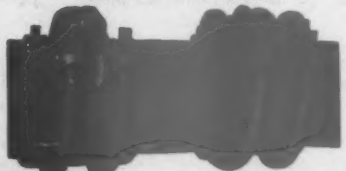


Fig. 7002 Fig. 7001
MADE WITH 1 OR 2 U-BOLTS
In Stock for Immediate Shipment
BROWN & BROWN, Incorporated
LIMA, OHIO, U.S.A.

Among the Drilling Contractors

Mac Drilling Co., Houston, Tex., is building road for 5 Cinco ranch, in the Clodine field, Fort Bend County, Texas, to be drilled for Stanolind Oil & Gas Co. It has the contract for drilling 7 Scanlan, on the east side of the Brazos River in the Thompson field, Fort Bend County, for Gulf Oil Corp. Mac is drilling below 4,000 ft. at 1 De Huck, in the Nordheim area of De Witt County, for Tide Water Associated Oil Co.

Shepherd Drilling Co. has been awarded contract to drill Del Fortney and C. W. Cook 1 Gerrit Bolks, in SE NE SE 25-4n-15w, Allegan County, Michigan.

Petroleum Well Service Co., Houston, Tex., has set surface pipe at 1 Marler, which it is drilling for Shell Oil Co., Inc., in the Bear field, Beauregard Parish, Louisiana. It completed 1 Duncan, a dry hole at 3,385 ft., for Jack Hutchins Co. in Wharton County, Texas.

Golding-Farris Drilling Co., Houston, Tex., is rigging up to drill 1 Robertson - McDonald in the Turtle Bay area of Chambers County, Texas, for R. J. Ursillo and Lombardo Brothers. It was milling out a window in the casing at 1 Cavazos, 12 miles southeast of Edinburg, Hidalgo County, preparatory to deepening the well from the original depth of 8,000 ft. to 9,500 ft. for Gulf States Oil Co.

McDannald Oil Co., Houston, Tex., was rigging up last week at 1 Hub Muske, to be drilled for Stanolind Oil & Gas Co. in the Katy area of Waller County, Texas.

Comanche Drilling Co., Blackwell, Okla., has finished a rotary hole and set pipe at 3,385 ft. on the Mary Duncan farm in NE SW 15-35-2e, Sumner County, Kansas, for Smith-Horten Co., of Seminole, Okla. The well will be finished with cable tools. Comanche has moved rotary tools and are now rigging up on the Rahn farm in SW NE SE 14-33-5e, Cowley County, Kansas, for George T. McNish, of Winfield, Kans.

Southern Drilling & Well Service Co., Houston, Tex., has the contract for drilling 1 Morgan-Kunetka, a wildcat test about 10 miles south of Gonzales in Gonzales County, Texas. It is below 6,000 ft. at 1 Duncan, 3 miles south of Lissie, Wharton County, which it is drilling for Edwin Neilson et al. It recently completed 1 J. W. Ragsdale, an unsuccessful wildcat, at 6,765 ft., for Neilson, 5½ miles southeast of Inez, in Victoria County.

Union Rotary Corp. will drill Sohio Producing Co. 2 C. Bowker, in S½ SW SW 32-19n-9w, Osceola County Michigan.

Clyde D. Lane, Cross Plains, Tex., has contract to drill a 3,350-ft. wild-

William M. Barret, Inc.
Consulting Geophysicists
Specializing in Magnetic Surveys
Contracts accepted for domestic and foreign projects, using the most improved instrumental and interpretative technique.
GIDDENS-LANE BUILDING
SHREVEPORT, LA.

KELLY WIPERS

For roller bearing Kellys in most sizes to fit Baash-Ross, Emsco and Ideco-Boykin models.

PATTERSON BALLAGH
CORPORATION
Los Angeles Houston New York City

cat test in northeastern Coleman County, Texas, for W. E. Ball and Charles P. Franchot. The test is located in the Luckenback Survey, 4½ miles west of Burkett.

Grey Wolf Drilling Co., Houston, Tex., will drill 1 Clara Hunt, 1½ miles west of Choate, Karnes County, Texas, a wildcat test for Adams Oil & Gas Co.

Robert W. Atha has contract to drill Gulf Refining Co. 1 Wieland-Knockel in C S½ NE SW 35-15n-4e, Bay County, Michigan. Contractor will also drill Rawmor Corp. 1 Herbert Kinsman, in C NE NW 17-16n-7w, Mecosta County.

J C. Arthurs, Inc., has contract to drill Freeman Oil Co. 1 Allen estate, in C E½ SW SE 19-23n-6w, Missaukee County, Michigan.

Ashby Drilling Co. will drill Gulf Refining Co. 1 Ruby-Don, in C S½ NW SE 6-16n-7w, Mecosta County, Michigan.

Lupher Drilling Co. has contract on Pure Oil Co. 2 J. C. Troeger, in C E½ SW NE 8-14n-11w, Newaygo County, Michigan.

Perry, Busk & Ormiston have been awarded contract to drill S. L. McCall 1 Timmerman, in NW NE NE 26-7n-15w, Ottawa County, Michigan.

Mendenhall & Jones, contractors of Emporia, Kans., will drill with rotary tools the Ferguson & Towle 1 Elizabeth Dillaplain, 7 miles south of Fairview, C SW NE 5-4s-15e, Brown County, Kansas.

B. & T. Drilling Co., Falls City, Neb., has been awarded contract to drill Powers Oil Co. 2 Bohrer, E½ SE NW 10-1n-14e, Richardson County, Nebraska. This will be an east offset to the company's 1 Bohrer, and a south offset to Nebraska Refining Co. 2 Bohrer.

T. J. Conway, Kilgore, Tex., has been awarded contract to drill a test in Harrison County, Texas, about 9 miles northwest of Marshall, for Mae Belcher. Drilling will commence on or before October 1.

Harvey H. Sims Drilling Co., Salem, Ill., has contract for W. E. Weidler 2 Layden Leeka, SE SE SW 13-20n-11e, Delaware County, Indiana.

Big Chief Drilling Co. is getting under way at Peter Fox Sons Co. 1 Mary A. Carsten, NE NE NE 5-32n-9w, Lake County, Indiana. It is a wildcat located in the southwestern part of the county, near the state line, and is some 10 miles west and north of the abandoned Thayer pool.

Top George, Mount Carmel, Ill., has contract for A. C. Thomas 1 Frank L. Bailey, SW SW SE 28-4s-13w, Posey County, Indiana. Location is east of the New Harmony pool.

J. A. Gray, Houston, Tex., has received a contract from Pure Oil Co. to drill 1 Tom Williams, in the new Blanconia field, 11 miles north of Refugio, in Bee County, Texas. This test is located 2,550 ft. east of the gas discovery, Pure 1 Tuttle, which opened the field and which also was drilled by Gray.

"TOPSALL"
THE RIGHT ROPE FOR YOUR RIGS
When you must have new rope for the bull wheels of drilling rigs, for catlines and other field-service jobs, here's what you and your crew can ask for and get in "TOPSALL" Treated Sisal.
• Uniformity of strength and flexibility
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TOPSALL is a genuine New Bedford product, given the same lubricating treatment as New Bedford's highest grades of manila when such rope was available.
New rope and old must be handled with care, conserved to the utmost. Write for this free booklet which tells you how.
NEW BEDFORD CORDAGE CO.
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WORTH WAITING FOR BUT NO WAITING IS NECESSARY

'BESTOLIFE—the Lead Seal Joint Compound used successfully in the Drilling and Refining industries for years—is immediately available through more than 100 distributors in the U.S.A. Any priority rating will do.

Your nearest supply house field store probably has 'BESTOLIFE in stock for immediate delivery. Use 'BESTOLIFE—it's BETTER!

MANUFACTURED BY

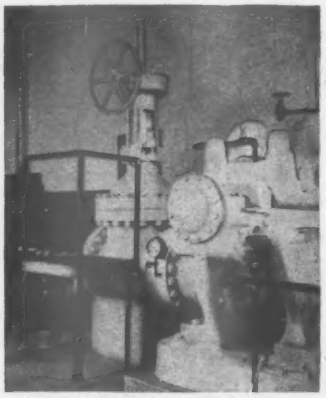
I. H. GRANCELL
1601 EAST NADEAU STREET
LOS ANGELES, CALIFORNIA

PIPE LINE VALVES
by Walworth

Ever since pipe line transportation of petroleum products was inaugurated, the Walworth Company—manufacturers of valves and fittings for more than a century—has supplied the petroleum industry with valves for pipe line service.

Many of the big pipe lines recently constructed are either all or partly equipped with Walworth Pipe Line Valves.

Walworth Company, 60 East 42nd Street, New York 17, N. Y.



Walworth Pipe Line Valves installed in pumping stations along the "Big Inch."

BOSTON WORKS
KEWANEE WORKS

WALWORTH
valves AND fittings

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

PERSONALS

F. TACKETT CLARKE

Pipe Lines Take the Place of Highways In His Career

F. TACKETT CLARKE, chief civil engineer of the Union Sulphur Co., Sulphur, La., is somewhat new to the oil and gas industry but in the span of 1 year he has accomplished enough to be termed almost a veteran.

Mr. Clarke is a graduate of Louisiana State University, receiving a degree in civil engineering and from 1928 until a year ago devoted most of his efforts to highway engineering. He has also done some engineering work for the Coast and Geodetic Survey and has been very successful in the investment business.

In July 1942 Mr. Clarke became associated with the Union Sulphur Co., large producers of oil and gas and formerly the world's largest producer of sulfur. This company owns and operates oil and gas pipe lines, a tank farm and marine terminal and is acting for the Defense Plant Corp. in the construction of a large diameter gas transmission system which is being greatly enlarged this year to serve the many defense industries in the Lake Charles, La., area.

Mr. Clarke has had direct charge of the design and construction of pipe lines, a tank farm, marine terminals and other structures during his very active service with the Union company.

Michael Joel, executive assistant to **Sumner T. Pike** in the Fuel Price Division, Office of Price Administration, has resigned to accept a position with the petroleum section of the Office of Economic Warfare. He was manager of the petroleum division of Amtorg Trading Co., New York, Soviet Russia trading commission, for several years before entering government service.

John Galloway of Calgary has been appointed president of the Dominion Oil Co., which is now operating in the Taber field of southern Alberta. **Lloyd N. Hamilton**, of Vancouver, B. C., who represented United States interests in the company, has resigned as president. **Floyd S. Bryant**, San Francisco, Calif., has been appointed chairman of the board of the company.

W. S. Ackerman, a member of the pipe-line department of Tide Water Associated Oil Co., with offices in San Francisco, Calif., is back on the job following an illness that incapacitated him for 2 weeks.

Capt. and Mrs. John A. Daugherty are the parents of a son born September 14. Captain Daugherty, who is stationed at Independence, Kans., was formerly connected with the Mid-Continent Supply Co.

W. E. BROWN

W. E. Brown, scout for Shell Oil Co., Inc., in the eastern Gulf Coast area of Texas, was elected president last week of the Houston Oil Scouts Association, one of the largest of such organizations in the country. He succeeds **Del Crosby**, of Humble Oil & Refining Co. **Paul Edman**, Tide Water Associated Oil Co., was elected first vice president, and **Roy Pickering**, Gulf Oil Corp., secretary-treasurer. **Hugh J. Roberts**, Gulf, was named editor-in-chief of the yearbook. **B. J. Krahn**, Texas Gulf Producing Co., was chosen delegate to the national convention, and **D. H. Janke**, Magnolia Petroleum Co., alternate.

William J. Judge, president of National Fuel Gas Co., Oil City, Pa., since 1919, will retire from active service October 1. He will be succeeded by **Leigh A. Brown**, who has been vice president, and also president of the subsidiaries located at Buffalo, N. Y. Mr. Brown will be succeeded as vice president by **William H. Locke**, who is also president of Pennsylvania Gas Co., Warren, Pa. Mr. Judge began his employment with the subsidiaries of Natural Gas Trust (predecessor of National Fuel Gas Co.) and with the pipe-line subsidiaries of Standard Oil Trust (later Standard Oil Co. of New Jersey) in 1890.

R. G. BAKER

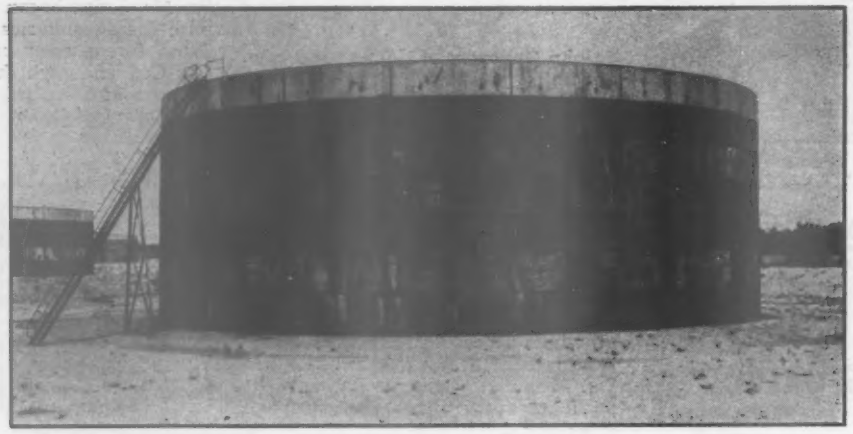
Rex G. Baker, director of Humble Pipe Line Co. and assistant general counsel of Humble Oil & Refining Co., Houston, Tex., has been made general counsel of the latter company succeeding **E. E. Townes**, who retired September 11. Mr. Baker joined Humble's legal department in 1920 and has been Mr. Townes' assistant for 6 years. He was a lieutenant in the first world war, was discharged as a captain and later became a lieutenant colonel in the Officers' Reserve Corps.

R. E. Beard, manager of Standard Oil Co. of Indiana's Sugar Creek, Mo., refinery, is on temporary assignment as assistant general manager of the manufacturing department at Chicago, Ill., while **J. E. Rouse** is on special detached service.

Oscar Hatcher, who has been geologist for Mid-Continent Petroleum Corp. for the past year, has resigned to become chief geologist for Helmerich & Payne, Inc., at Tulsa.

E. F. Pinney, who has been in charge of the mechanical department since 1936, has been appointed assistant superintendent of the Pratt (Long Island) refinery of Socony-Vacuum Oil Co., Inc. He has been employed by the company since 1931 when he joined its general laboratories' technical service division at Greenpoint.

Safe Storage



"on the BIG INCH"

Safe storage is always important. We are proud to be identified as the "Erectors of Steel Storage on the Big-Inch Line."

We offer modern facilities for the construction of steel storage

★

STEEL TANK CONSTRUCTION COMPANY

DALLAS, TEXAS *and* **HOUSTON, TEXAS**

Market Developments

East Coast

NEW YORK. — In spite of the improvement in the District 1 gasoline-supply situation, the New York district office of OPA, having jurisdiction over the states of New York, New Jersey, Pennsylvania, Maryland, Delaware and the District of Columbia, has announced plans to recheck the allotments of B and C coupon holders. The announced purpose of the plan is to effect a saving of 24,000,000 gal. per month in gasoline consumption.

Announcement of the plan to recheck B and C cardholders' allotments was accompanied by the admission from OPA that some overissuance had taken place, a fact which it heretofore had not publicly admitted. The availability of excess coupons, however, made it a virtual certainty that this was the major contributing factor to the excess gasoline consumption and that a reconsideration of B and C allotments would go far toward correcting the shortage.

The index of available supplies on the East Coast continued its rise, moving up 1.6 points to 41.9. For the first time in weeks increased gasoline stocks were believed to have contributed to the improvement. The level of 41.9 compares with 60.1 a year ago, the peak for late 1942.

Gulf Coast

HOUSTON, Tex. — Small and scattered supplies of high diesel-index gas oil were reported to be available in the Gulf Coast territory this week, affording virtually the only sign of mild relaxation of an acute scarcity of oil products. A few refiners and marketers suggested there might be a slightly easier tone in kerosene and light distillate fuels, but a majority declared that, with the one exception mentioned, they could see only a further tightening of an already skintight market.

Aggravating the shortage of refined products, Phoenix Refining Co. has been obliged to shut down its Houston plant as a result of fire, which caused heavy damage. The plant ran 2,200 to 2,500 bbl. of crude to stills daily. Its gasoline output averaged about 50,000 gal. daily, and kerosene 18,000 gal., along with the usual yield of heavier products. Removal of such a volume of finished material from the Gulf Coast market under the existing strained conditions has multiplied the difficulties of buyers seeking sources of supply.

The transportation problem, generally referred to recently as having vanished or at least to have shrunk to such a point that it no longer need cause worry, is declared by some refiners to be still sprinkled with nettles for them. Notwithstanding cheerful talk, they say they find clean cars hard to get. Such tank-car difficulties as remain are expected to be pretty well cleared up by the release of cars which have been used in the transportation of crude from the Norris City, Ill., terminal of the Big Inch pipe line to the East. Several hundred of these, it is understood, will be sent to this district, where they will be cleaned and put into service moving refined products.

Mid-Continent

INCREASINGLY heavy buying pressure for natural gasoline continued this week to feature Mid-Continent product markets. Refiners and blenders were offering premium prices of an eighth to a quarter of a cent above current quotations in an effort to entice additional supplies into the market.

Manufacturers, however, were unable to meet demand and reported that supplies are virtually on a day-to-day basis. Material held in storage on the Gulf Coast through most of last year and the first half of this is completely liquidated, it was reported this week.

Tightness of refined products was unchanged. Refiners were unable to meet all calls for motor gasoline which continue brisk, particularly from the agricultural areas of the Middle West. Maintenance of quota shipments, aggregating 50,000 bbl. daily from District 2 into District 1 states, is taxing Mid-Continent plants chiefly because of their inability to augment receipts of crude oil.

Arrangements for tank-car movement of 25,000 bbl. daily of West Texas crude from Midland, Tex., to District 2 refinery points may serve to modify the existing shortage. But plant operators generally agreed that a substantially larger volume would be required to bring measurable relief.

Pacific Coast

LOS ANGELES, Calif. — The California State Board of Equalization announced this week that gasoline sales in California for the month of July were only 6.9 per cent below sales during the comparable month last year despite the fact that rationing was not then in force. The July 1942 tax was 14.3 per cent under the all-time high established in July 1941 but it exceeded sales during July 1940, which had been the previous high point.

The current sales definitely indicate the decline resulting from rationing is leveling off sharply. The delay in making public the amount of sales in California during July is due to the fact that the state legislature extended the reporting time by an additional 2 weeks in order to take care of labor shortages incident to the war.

The decline in California gasoline sales began with a drop of 40 per cent last December and in the ensuing months showed a progressively lower decline. The declines shown were 34, 26, 22.6, 15, 13 and 9 per cent. At present the decline is less than 7 per cent. It is estimated that during 1943 sales of gasoline will be about 85 per cent of normal expectations. The declines registered from last year do not reflect any relaxation in rationing but rather indicate a tremendous increase in population made necessary by the great expansion in war plants.

There were no changes in the wholesale market and there appears a tightening up in the crude-oil market coincident with a strengthening in gasoline prices. Natural gasoline has been very tight for several months and gas oil with a normal cetane rating is not to be had except in small lots.

A.P.I. REFINERY REPORT

(Figures in thousands of barrels)

Week Ended September 11, 1943

	Dly. crude runs to stills	Stocks: Gasoline	Stocks: Residual	Stocks: Gas oil
Appalachian	151	2,293	513	824
Ind., Ill., Ky.	749	14,096	3,356	5,932
Okla., Kan. Mo.	329	5,992	1,656	2,255
Censored area*	2,158	30,885	17,319	17,810
Rockies	115	1,278	784	416
California	714	17,384	43,493	12,154
Total 9-11-43	4,216	71,928	67,001	39,401
Total 9- 4-43	4,214	71,402	67,675	38,673
Total 9-12-42	3,737	80,224	79,019	44,216

*Reports combined on East Coast, Texas Gulf, Louisiana-Arkansas and Inland Texas at request of PAW.

CRUDE-OIL STOCKS

(Bureau of Mines Estimate)

Week ended:	Bbl. of crude*
September 11, 1943	234,389,000
September 4, 1943	234,635,000
September 12, 1942	244,871,000

*Excludes unrefinable California stocks.

Refinery Prices

(Prices as of September 21)

Quotations are f.o.b. plant in cars and in cents per gallon except where otherwise noted. They are exclusive of the federal excise taxes of 1.5 cents a gallon on gasoline and 4.5 cents a gallon on lubricating oils, and do not include marine lighterage charges.

REFINERY GASOLINE

Octane (A.S.T.M.):	†80	74-76	70-72	68-70	63-66
Mid-Continent*	.....	.....	6.000	.....	5.625
Pennsylvania	.....	6.750-7.000	.....	.....	.....
Gulf Coast	6.00-6.50	.....	§5.750-6.250	§5.750-6.250	§5.250-5.750
Northeast Coast	9.00	.....	9.2	9.2	.....
California	6.750-7.500	6.250-6.500	6.125-6.250	5.750-6.125	5.125-5.500

*Basis Group 3. †1930 C.F.R. (research method). §Unleaded.

KEROSENE AND NO. 1 FUEL OIL

Gravity:	46	45	42-44	41-43	38-40
Mid-Continent*	.....	.....	4.500	4.375	.....
North Louisiana	.....	.....	.....	4.500-4.750	.....
Pennsylvania	6.250-6.625	6.125-6.250	.....	.....	.....
California	.....	.....	.....	4.500-5.500	4.250
Northeast Coast	.....	.....	.....	6.00	.....
Gulf Coast	.....	.....	.....	4.125	.....

*Basis Oklahoma Group 3.

TRACTOR, DIESEL, AND BUNKER FUEL OIL

Specifications:	46-48° G.	24 D.I.	48-52 D.I.	56 & above	Diesel bunkers	Residual Bunker C†
Mid-Continent*	4.125	.....	.....	.....	.....	$0.80-1.27
California	.....	2.750-4.000	.....	.....	‡1.35-1.45	0.85-1.00
Gulf Coast	.....	.....	4.000	4.125	1.45	0.85-1.27
Northeast Coast	.....	.....	.....	6.800	2.700	1.65-2.07
North Louisiana	.....	.....	.....	.....	.....	0.80-1.27

*Basis Oklahoma Group 3. †Gravity range. ‡Pacific Specification 300

FURNACE OIL, GAS OIL, FUEL OIL

	No. 2	No. 3	No. 5	No. 6
Mid-Continent*	3.625	3.500	$0.85	$0.80
Pennsylvania (West)	5.875-6.125	5.875-6.000	†5.250-5.500	.....
Northeast Coast	6.7	6.7	1.95	1.65
California	5.5	5.5	‡1.10-1.25	§1.10-1.15
Gulf Coast	3.750-3.875	.....	1.35	0.85

*Basis Oklahoma Group 3. †36-40 gravity fuel. ‡Pacific Specification 300 §Pacific Specification 400.

NATURAL GASOLINE

Grades:	26-70	18-56
Oklahoma (Group 3)	4.375	5.125
North Texas	4.000	4.125
North Louisiana	4.125	4.250
California	4.875	5.500

LUBRICATING OILS

Bright and Steam Refined

OKLAHOMA (Group 3)—

200-210 D. 10-25	27.00
150-160 D, 0-10	23.00
120-125 D, 0-10	22.00
Steam refined:	
600 dark green (untreated)	9.00

PENNSYLVANIA—

Bright Stocks (Pennsylvania Grade No. 8 color, 140-150 at 210, 545-550 flash)		
10 pour point		30.50
15 pour point		29.50
25 pour point	25.00	26.00
Steam refined:		
600	15.00	16.00
650	15.50	16.50
600 flash	16.00	17.50
650 flash	17.00	17.50

Neutral Oils

Vis. at 100° F. except Pennsylvania and color N.G.A.)

OKLAHOMA (Group 3)—

0-10 pour point:	
200-3	15.00
300-3	18.00
500-3	19.50
600-3	20.00

Note: Viscous neutrals, 10-25 pour, quoted 0.5 cent under 0-10 oils.

CALIFORNIA—

200-2½-3	7.00	7.75
400-3-4	7.25	8.00
600-3-4	8.75	11.00

Neutral Oils

Red oils:		
200-4-5	7.00	7.75
400-5-6	9.00	11.00
500-900, 5-6½	9.25	11.25

GULF COAST—

Pale oils:		
200-3	8.50	8.75
300-3	9.00	9.25
500-3½	9.75	10.00
750-3½	10.00	10.25
2,000-4	10.50	10.75
3,000-4	12.25	12.50

PENNSYLVANIA—

150 vis. at 70° F., 3 color, 400-405 flash:	
Zero pour point	37.50
10 pour point	36.50
15 pour point	35.50
25 pour point	30.00
200 vis. at 70° F., 3 color:	
Zero pour point	39.50
10 pour point	38.50
15 pour point	37.50
25 pour point	32.00

WAX

(Cents per pound)

OKLAHOMA (Group 3)—	
124-126 (A.m.p.) w.c. scale	4.250
PENNSYLVANIA (Inland refineries)—	
122-124 (A.m.p.) w.c. scale	4.250
124-126 (A.m.p.) w.c. scale	4.250
NEW YORK—	
Wax in bags fully refined:	
120-122 (A.m.p.) wax	5.850
132-135 (A.m.p.) wax	6.150
Crude scale:	
124-126 (A.m.p.) w.s.	4.200
124-126 (A.m.p.) y.s.	4.250

TANK-WAGON PRICES IN 50 CITIES

(Gasoline prices based on regular grades, tax included, undivided dealer)

ATLANTIC AND NEW ENGLAND

(Socony-Vacuum Oil Co., Inc., and Atlantic Refining Co.)

	Dealer tank wagon	Combined tax	Kero. tank wag.
Baltimore, Md.	15.95	5.50	10.50
Boston, Mass.	14.90	4.50	10.10
Burlington, Vt.	16.90	5.50	10.20
Buffalo, N. Y.	16.20	5.50	10.90
Dover, Del.	16.70	5.50	12.20
Hartford, Conn.	15.60	4.50	10.00
Manchester, N. H.	17.30	5.50	12.10
Newark, N. J.	15.20	4.50	10.00
New York, N. Y.	16.10	5.50	10.10
Philadelphia, Pa.	16.20	5.50	11.95
Pittsburgh, Pa.	16.70	5.50	12.30
Portland, Me.	16.30	5.50	10.20
Providence, R. I.	15.00	4.50	9.90
Washington, D. C.	15.20	4.50	11.20
Average 14 cities	16.02	5.14	10.88

(All prices undivided dealer basis.)

CENTRAL

(Standard Oil Co. of Indiana, Standard Oil Co. of Ohio, Continental Oil Co. and Texas Co.)

	Dealer tank wagon	Combined tax	Kero tank wag.
Chicago, Ill.	14.10	4.50	10.00
Cleveland	15.00	5.50	*9.00
Dallas, Tex.	13.00	5.50	7.00
Des Moines, Iowa	14.40	4.50	10.10
Detroit, Mich.	14.40	4.50	10.00
Fargo, N. D.	16.90	5.50	11.00
Huron, S. D.	16.30	5.50	11.00
Indianapolis, Ind.	15.00	5.50	10.10
Little Rock, Ark.	17.50	8.00	10.00
Milwaukee, Wis.	16.10	5.50	10.80
Minneapolis, Minn.	15.90	5.50	10.00
Omaha, Neb.	15.40	6.50	9.90
Tulsa, Okla.	16.50	7.00	8.50
Wichita, Kans.	13.30	4.50	8.70
Average 14 cities	17.46	5.57	9.84

*Includes 1-cent state tax.

SOUTHEASTERN

(Standard Oil Companies of New Jersey, Kentucky, and Louisiana)

	Dealer tank wagon	Combined tax	Kero tank wag.
Atlanta, Ga.	18.90	7.50	*11.50
Birmingham, Ala.	18.50	8.50	9.00
Charleston, S. C.	18.95	7.50	
Charleston, W. Va.	19.25	6.50	13.30
Charlotte, N. C.	20.10	7.50	11.30
Jacksonville, Fla.	18.90	8.50	9.50
Jackson, Miss.	17.90	7.50	†9.00
Louisville, Ky.	16.50	6.50	8.50
Memphis, Tenn.	17.90	8.50	10.50
New Orleans, La.	17.75	8.50	10.00
Norfolk, Va.	17.45	6.50	12.20
Average 11 cities	18.34	7.50	10.50

*Includes 1-cent state tax.
†Includes ½-cent state tax.

MIDWESTERN

(Continental Oil Co.)

	Dealer tank wagon	Combined tax	Kero tank wag.
Albuquerque, N. M.	17.50	7.50	10.00
Boise, Idaho	20.10	6.50	16.50
Casper, Wyo.	17.00	5.50	12.00
Denver, Colo.	14.50	5.50	11.00
Helena, Mont.	17.00	6.50	13.00
Phoenix, Ariz.	18.50	6.50	12.50
Reno, Nev.	17.50	5.50	13.50
Salt Lake, Utah	18.50	6.50	14.50
Average 8 cities	17.56	6.25	12.88

PACIFIC COAST

(Standard Oil Co. of California)

	Dealer tank wagon	Combined tax	Kero tank wag.
Portland, Ore.	17.00	6.50	13.50
San Francisco, Calif.	14.50	4.50	11.50
Seattle, Wash.	17.00	6.50	13.50
Average 3 cities	16.17	5.83	13.00
Average 50 cities	16.59	5.96	10.92